Environmental good practice on site guide (fifth edition)



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CIRIA C811 London, 2023

Environmental good practice on site guide (fifth edition)

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Environmental good practice on site guide (fifth edition)

Kwan, J, Dickinson, C, MacLeod, C

CIRIA

C811 © CIRIA 2023 RP1138 ISBN: 978-0-86017-955-9

British Library Cataloguing in Publication Data

A catalogue record is available for this book from the British Library.

Keywords	
Construction process, contaminated land, environmental management, sustainability, waste management, material	
Reader interest	**Classification**
Construction process, environmental management, sustainability, ecology, archaeology, nuisance, dust and odour, light, noise and vibration, land contamination, materials, waste management, water management, traffic management	Availability: Unrestricted Content: Advice/guidance Status: Committed guided Users: Site managers and operatives

Published by CIRIA, registered office: 124 City Road, London, EC1V 2NX, UK

Please cite this publication as:

KWAN, J, DICKINSON, C, MACLEOD, C (2023) *Environmental good practice on site guide (fifth edition)*, C811, CIRIA, London, UK (ISBN: 978-0-86017-955-9
www.ciria.org

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Summary

Every construction project has environmental requirements that need to be well-managed by the site manager and workers on site.

CIRIA C741 *Environmental good practice on site guide (fourth edition),* which was published in 2015, provides essential guidance to site managers. The construction industry has come under increasing pressure to reduce negative environmental impacts. With the introduction of the Environment Act 2021, construction projects are expected to be carried out at higher environmental standards and achieve new national environmental commitments, such as net zero emission by 2050.

This guide provides up to date practical guidance on delivering sustainable construction at the site level, which includes:

- ecology, protected species and habitats
- historic environments and archaeological remains
- land contamination
- nuisance (eg noise, vibration, lighting, dust, emissions, odours)
- resources (eg energy, materials, water and waste)
- traffic and travel arrangements, and vehicle use.

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Acknowledgments

This fifth edition has been undertaken in collaboration with a project steering group (PSG) of industry practitioners. It has been written by Joanne Kwan (CIRIA), Claire Dickinson (independent consultant) and Cecilia MacLeod (Greenwich University).

CIRIA would like to acknowledge those involved in previous editions of the site guide – C502 (1999), C650 (2005), C692 (2010) and C741 (2015).

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CIRIA would like to thank the following organisations for providing figures (diagrams and photographs) and case studies: Arcadis, Arup, BAM Nuttall, Brookfield Multiplex Europe, Bureau Veritas, Galliford Try plc, the Green Construction Board, Kier, Laing O'Rourke, Mace Group Ltd, Oxford Archaeology, Soilfix, Skanska, Willmott Dixon.

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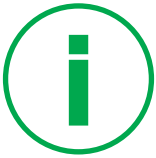
This site guide provides guidance on environmental good practice for site staff working on construction projects. It covers all site activities until the project is handed over to the client.

The guide is intended to be a reference book and training aid; it provides the basis of CIRIA's *Environmental good practice on site* training course. It also complements CIRIA's toolbox talks: **https://www.ciria.org/CIRIA/Resources/Toolbox_talks**

Throughout the guide the following symbols are used alongside the text to help identify the type of information being presented:


Case study


Checklist


Further information


Key guidance


Take note

This site guide:

- is not a health and safety manual
- should not replace engagement with regulators
- does not deal with environmental issues that should have been covered during the planning and design of the project.

Generally, the advice given in the guide is relevant for all types of contract conditions, eg traditional, design and build (D&B), design-build-finance-operate (DBFO), build-operate-transfer (BOT) and private finance initiatives (PFI).

Issues relating to the terrestrial environment are discussed in this guide. For the coastal and marine environment readers are directed to CIRIA C744 *Coastal and marine environmental site guide (second edition)* (John *et al*, 2015) and CIRIA C745 *Coastal and marine environmental pocket book (second edition)* (John *et al*, 2016).

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1 Environmental benefits and obligations

This chapter provides an overview of the benefits and obligations of environmental good practices on site.

1.1 IMPROVE FINANCIAL PERFORMANCE OF BUSINESS AND STAFF WELL-BEING

Reducing waste, minimising energy use, decreasing the risk of pollution and avoiding prosecution can improve business efficiency. Environmental, social, and governance (ESG) is a framework to evaluate the sustainability of an organisation and is often used by stakeholders for investment and funding decisions, or when procuring new business relationships. Good environmental practice on site is part of a strong ESG proposition and increases opportunities for business growth and performance.

Good environmental practice on site also means a cleaner, healthier, and safer working environment for site workers. This reduces time lost through injury and illness as well as demonstrating a company's commitment to the well-being of its staff, improving the image of construction sites and attracting more people to enter the industry.

1.2 MEETING LEGAL, REGULATORY, AND OTHER OBLIGATIONS

Since 1999, there have been significant changes within the UK regulatory environment with respect to construction and environmental protection. The austerity years saw a shift with respect to planning regulations and the link between planning and environmental protection; post-Brexit there are likely to be more changes that affect site practice.

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1.2.1 National environmental protection legislation

Violation of environmental protection legislation, resulting in court convictions, can lead to unlimited fines for a company and/or imprisonment or community service for the responsible person and/or appropriate director or senior manager.

Liability can also result in harsh penalties if it is found that suitable training, procedures, or equipment were not being provided to workers on site. Environmental convictions can preclude companies from tenders/frameworks and can mean environmental permits being refused and/or revoked preventing current or future activity from being undertaken.

In 2018, the UK Government set out its commitment to improve the environment in *A green future: our 25 year plan* (HM Government, 2018a). More recently the Environment Act 2021 set further environmental targets such as 10% Biodiversity Net Gain (BNG) for all new developments in England and introduced the Office for Environmental Protection (OEP) which has enforcement power to "*identify and respond to serious failures to comply with environmental law by anyone else carrying out activities of a public nature*". This means that construction professionals need to pay more attention to environmental performance on site.

1.2.2 Employer/client requirements

Contract conditions between client and consultant, contractors and other professional advisors allow businesses to define the environmental standards that will be achieved on site during construction. They provide the opportunity to set targets, specify site resource management protocols, define scheme improvements, improve biodiversity, and get buy-in from subcontractors etc. The employer/client environmental requirements and planning conditions together can also form specific contractual conditions.

1.2.3 Local authority and other regulator control

Planning legislation at both a local and national level is the main control on construction development. Planning conditions are often imposed on a project to ensure the commitments made to the environment and local communities are delivered. This may include:

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- provisions made after an Environmental Impact Assessment (EIA)
- complying with strategies agreed with a planning authority to monitor site activities such as traffic movement, dust, and noise, which could affect the wider community etc.

Government agencies such as the EA, NRW, SEPA and NIEA can also impose local controls on site activities.

The regulators

The Environment Agency (EA), Natural Resources Wales (NRW), Scottish Environment Protection Agency (SEPA) and the Northern Ireland Environment Agency (NIEA) enforce environmental protection legislation to protect both the natural environment and residents around development. Natural England and Nature Scot are responsible for enforcing laws that protect wildlife and the natural environment in England and Scotland respectively; Historic England and Historic Environment Scotland are the guardians of cultural heritage.

1.2.4 Corporate control

Many construction companies have corporate environmental/sustainability policies (and associated action plans), key performance indicators (KPIs) and an environmental management system (EMS), which may be accredited to BS EN ISO 14001:2015 (see **Section 2.6**).

There may be a site-specific environmental management plan (EMP) for a project, which is often generated from the EMS that stipulates the necessity to protect and/or identify opportunities to enhance the environment. It will also set specific targets for achieving company environmental objectives for construction projects (including on site activities).

Under planning/consent conditions, the EMP may also be required to demonstrate, support, and implement environmental commitments and supporting applications for biodiversity and landscape conservation that will also affect site works. **Appendix A1** provides an example of EMP content.

1.3 IMPROVE REPUTATION

Legal compliance and adopting good practices will improve a construction company's reputation with customers and local communities. Good environmental credentials can also help to win contracts. This includes achieving ratings in

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environmental assessment schemes or being able to register for environmental schemes. Good environmental practice on site contributes to obtaining scores/credits for these schemes (see **Appendix A2**), from evidence collected during the works, such as site monitoring data.

1.4 ACHIEVING SUSTAINABLE CONSTRUCTION

The term 'sustainable construction' has evolved in recent years, and its meaning may vary between architects, developers, regulators, and site workers. The goal is to reduce the negative impact of construction on the environment, people, places, and resources, and to provide an improved quality of life. The UK Green Building Council (UKGBC) has set out a vision of change for the industry by 2027 based on five principles:

1 Mitigating and adapting to climate change.

2 Eliminating waste and maximising resource efficiency.

3 Embracing and restoring nature and promoting biodiversity.

4 Optimising the health and well-being of people.

5 Creating long-term value for society and improving quality of life.

Good practice on site can help construction project to achieve these principles.

1.5 THE UK COMMITMENT TO MANAGING CHANGING CLIMATE

There is no doubt that the climate is changing. Reducing greenhouse gas (GHG) emissions, such as carbon dioxide, is vital to climate change mitigation.

The UK aims to cut carbon emissions by 78% compared to 1990 levels by 2035 and achieve carbon net zero by 2050 (DESNZ and BEIS, 2022).

Activities on construction sites can play a vital role in helping to reduce carbon emissions.

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Further reading

CABINET OFFICE (2022) *The Construction Playbook. Government Guidance on sourcing and contracting public works projects and programmes*, version 1.1, HM Government, London, UK
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ZERO WASTE SCOTLAND:
Circular construction: **https://zerowastescotland.org.uk/our-work/circular-construction**

Maximising re-use in construction: **https://zerowastescotland.org.uk/construction/maximising-reuse**

Improving waste management on construction sites:
https://zerowastescotland.org.uk/construction/waste-management-on-site

Create a site waste management plan:
https://zerowastescotland.org.uk/construction/waste-management-plan

Standards

BS EN 15978:2011 *Sustainability of construction works. Assessment of environmental performance of buildings. Calculation method*

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2 General project management

All sites should have an EMP which site staff are familiar with. It is the site manager's responsibility to ensure that procedures are put in place that may be incorporated into daily toolbox talks to keep a site in compliance with environmental regulations, the EMP and protect the health of site staff and the environment.

2.1 WHAT TO PREPARE TO GO ON SITE

Figure 2.1 describes the general steps to good environmental practice on site:

1 **Identify environmental obligations.** This includes identifying environmental assessment (EIA documentation), associated reports and surveys, legal obligations and other regulatory, contracts requirements.

2 **Identify the environmental aspect and impact of associate with site activities.** This includes reviewing the information gained in Step 1. Compile with an environmental impact register for the site that link site activities with sensitive receptor(s).

3 **Identify environmental responsibilities.** Define the responsibilities of all site staff and lines of communication. Ensure site staff receive the appropriate training and resources to carry out their work.

4 **Establish the appropriate plans to manage the activities:**

   a Information gathered in Steps 1 to 3 should form the basis of necessary plans, and include an overarching EMP which is site specific, accessible, and regularly reviewed (and updated if needed).

   b Use the EMP to develop a method statement (MS) for specific aspects of site activities. Other plans to support management on site include emergency or a SWMP.

During site inductions, make sure that all site staff understand that there is a duty of care on everyone to report any issues (eg spills, damage to materials, or complaints from neighbours) that are encountered during the construction phase of a project.

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5 **Plan for monitoring.** Monitoring provides baseline data that can be used for setting objectives and targets. It will also give information about the effectiveness of the mitigation so that improvements can be made.

Monitoring is needed for a wide range of activities, including:

a energy and fuel use

b audit report findings

c evidence of waste duty of care (volumes, classification, storage, disposal, and waste transfer documentation)

d records of dust generation (including composition)

e noise, air and water quality, and vibration/movement monitoring records

f licence conditions

g verification of land contamination mitigation measures, for example inspecting and testing gas protection measures.

Before site work begins, the monitoring programme should be planned and how results should be retained and stored be confirmed.

Daily logs should be produced and kept on site. These should include monitoring data collected on the day, and accidents, near misses/incidents/spillages, and a copy of the toolbox talk.

See also **Chapter 4.**

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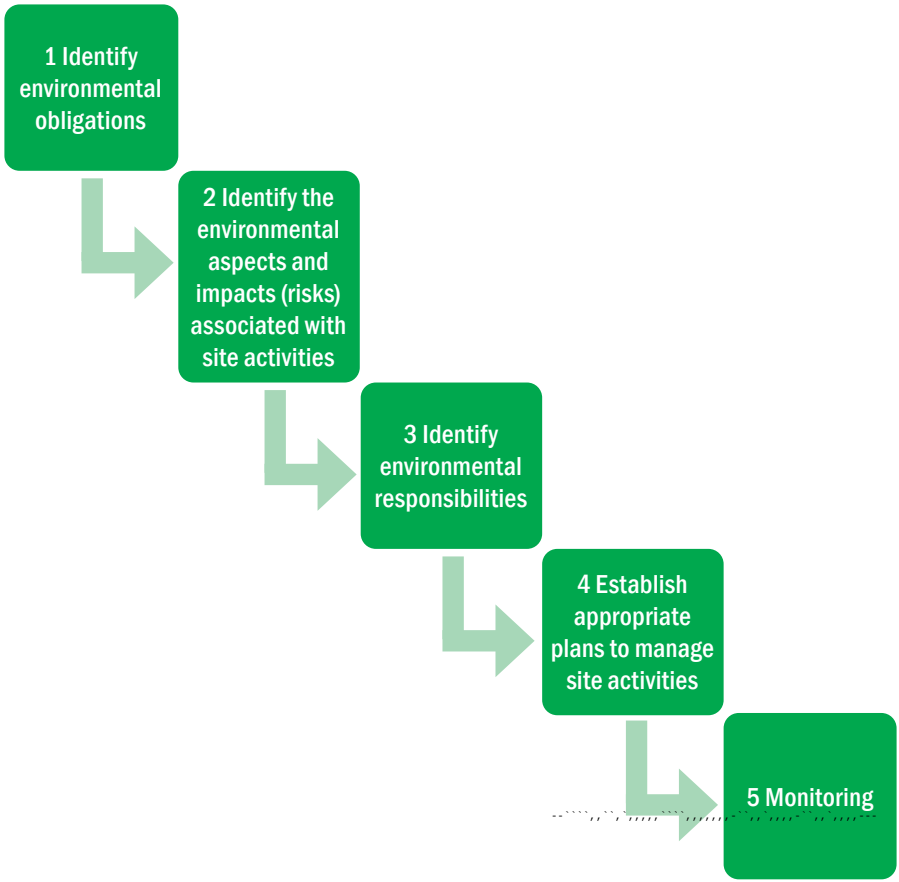


Figure 2.1 Steps for managing environmental good practice on site

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2.2 ENGAGING WITH THE LOCAL COMMUNITY AND REGULATORS

2.2.1 Communication with the local community

Developing effective communication with the local community is important to construction projects. If the community is aware of what is happening, it is likely that complaints will be reduced. Communication should be initiated, where possible, at the planning stage, or at the start of the project and continued throughout.

Good practice checklist (note that some are only appropriate to large sites)

Liaising with local community	✓
Identify and keep key local community representatives, such as parish councillors and residents' representative, engaged: • use public meetings with the local community and stakeholders as an opportunity to listen and reassure • explain the efforts and other mitigation measures that are being made to limit the negative environmental impacts of site activities	
Visit occupants of sensitive buildings (eg schools, nursing homes and hospitals) and keep them informed of progress	
Prepare a leaflet and distribute it to nearby residents or occupiers. Provide updates, or regular contributions, to existing community newsletters and on websites	
Write articles for the local media about the progress on site	
Display a 'contact board' at the site perimeter display information on project phasing and other relevant matters so that the public know who to contact if they have a complaint or a comment	
Consider joining the Considerate Constructors Scheme (CCS) (see **Appendix A2**)	
Establish a complaint telephone line and email	

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Liaising with local community	✓
Deal quickly with any complaints that arise and in accordance with a defined complaints procedure. Create a log of complaints. Make sure all complaints are properly followed up and resolved, and the responses to them are recorded	
Issue site staff with contact cards to give to the public if approached to ensure complaints/queries are dealt with effectively	
Install observatory panels in the site hoardings	

2.2.2 Site staff and off-site actions

Site staff and off-site actions that can cause annoyance to the local community include:

- noise when arriving or leaving site
- too many site-based staff in local shops
- offensive language and behaviour
- vehicle parking on residential streets
- leaving vehicles running
- playing loud radios
- litter dropping.

Procedures should be in placed to ensure the site staff will be considerate and their actions/behaviour will not cause nuisance to the general public.

2.2.3 Working with regulators

Whatever the size of the project it will be necessary to work with regulators. Regulators have a diverse range of specific responsibilities and powers to enforce legislation. Some of their main responsibilities are included in **Table 2.1**. Regulators will visit the site to conduct audits and ensure that planning conditions/licences/permits are being adhered too.

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Table 2.1 Regulators and their core responsibilities

Regulator	Responsibilities/technical areas that the regulator look after
Local authorities in England and Wales, local authorities and SEPA in Scotland, district councils in Northern Ireland	Nuisances, air quality, traffic, the planning process, environmental permits, land contamination, and flooding when acting as lead local flood authority (LLFA).
Environmental regulator (ie EA, SEPA, NRW, NIEA)	Discharges to land, air and water, waste, water abstraction, ground and water contamination, water and land quality, engineering activities in or near waters, and environmental permits/licences. For NIEA and NRW these also include nature conservation.
Natural England	Designated ecological sites, geological and geomorphological sites and protected species and habitats. Licenses for movement of organisms.
Nature Scot	Conservation of the natural environment including designated sites and protected species. Licensing for movement of species including reintroductions. Outdoor access code of practice.
Council for Nature Conservation and the Countryside	Provides advice to Department of Agriculture, Environment and Rural Affairs (DAERA) on matters affecting nature conservation and the countryside.
Historic England, Historic Environment Scotland, Historic Environment Division Northern Ireland, Cadw	Designated archaeological and heritage sites (including designated buildings).
County archaeologist	Advise local planning authorities (LPAs) on the impact of development on archaeological sites and how they can be mitigated.
Health and Safety Executive (HSE)	Health and safety issues including vibration and asbestos.
Water and sewerage provider	Effluent discharge to public sewer (also combined drains and surface water drains), and supply of water.

Box 2.1 contains tips on working with regulators.

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Box 2.1 *How to work with regulators*

Dealing with regulators

- Plan ahead and give regulators advance warning of potential issues.
- Allow regulators the time they need to process the enquiry, particularly when applying for permits/licences/consents – note that the application processes can take many months.
- Ensure site staff know the correct procedures for reporting incidents to the regulators.
- Always notify the relevant environmental regulator of any pollution incidents or other environmental damage.

2.3 ENVIRONMENTAL RESPONSIBILITIES

Everyone on site is responsible for ensuring that their actions constitute environmental good practice. Certain individuals have clearly defined roles and responsibilities as detailed in **Table 2.2**, which is not an exhaustive list; levels of responsibilities can vary within companies.

Table 2.2 *Roles and responsibilities of construction professionals*

Individual	Role
All site staff	• Follow good practice and should carry out their activities without detrimental effects on the environment. • Comply with systems of work including the EMP, MS and risk assessments, and should carry out tasks in accordance with their training. • Responsible for reporting any environmental concerns and incidents to their supervisors, including suggestions for improvements.
Site engineers/ foremen	• Understand the project environmental obligations and the practical measures that needed to be complied. • Ensure that the control measures identified (eg EMP, MS) are effectively carried out. • Ensure monitoring data is collected and monitoring points are protected. • Identify the need for, and are suitably experienced to deliver, regular toolbox talks.

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Individual	Role

Site manager	• Principal responsibility for environmental management on site by ensuring:
	  ○ all measures in the EMP, including consents, are obtained and implemented, and that adequate resources are allocated to environmental management
	  ○ environmental issues in MS/risk assessments are effectively communicated and appropriate training (including an induction) is delivered.
	• Ensures all verification and monitoring data is collected, uploaded, and recorded in the BIM, or stored safely so that it is available for discharge of planning conditions and compliance with waste duty of care.
	• Conducts regular environmental inspections and provides information to environmental advisors.
	• Carries out the client's environmental instructions.
	• Investigates, corrects and prevents incidents and non-conformances from reoccurring.

Environmental manager (site or office based)	• Provides corporate advice on environmental legislation, good practice and the company's environmental policy; translates decisions into action at site level. • Reviews site team competency and provides appropriate environmental training. Responsible for notifying the client of asbestos, UXO, unknown contamination, or if protected species are encountered. Liaises with the site manager to ensure environment monitoring and verification data is being collected. • Reviews overall environmental performance and compliance of the project. Carries out or arranges for site environmental audits to be undertaken. Takes action to resolve any non-compliance issues that may arise. • Liaises with all appropriate stakeholders, including regulators as required.

Environmental co-ordinators/advisors, clients, and directors with responsibility for environment/executive board also play important roles in the implementation of the EMP.

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2.4 THE SUPPLY CHAIN

Before starting work on site, the developer should have selected their preferred suppliers based upon their ability to meet the developer's and client's sustainability objectives.

Good practice checklist

What subcontractors need to do and know	✓
Sign up to the implementation of the EMP and other site-specific plans, such as the SWMP/RMP before starting work	
Attend environmental training sessions/inductions (eg using toolbox talks)	
Know their environmental obligations on the project including data collection and verification requirements	

2.5 TRAINING OF SITE WORKERS/ CONTRACTORS ON ENVIRONMENTAL OBLIGATIONS

Site staff need to:

- have access to relevant information; many contractors, particularly on large projects, employ a wide range of subcontractors with different expertise working on different environmental aspects of a construction project. Information provided by these subcontractors and specialists needs to be conveyed to site staff efficiently
- have adequate, regular and appropriate training.

Training can be face-to-face, virtual, and/or via toolbox talk.

CIRIA provides:

- A series of free toolbox talks: **https://www.ciria.org/CIRIA/Resources/Toolbox_talks**
- On-site training guidance: **https://www.ciria.org/CIRIA/Training**

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All training should be specific and appropriate to the audience, and attendees' understanding should be monitored throughout via tests, discussions, inspections, audits etc. Site staff doing certain works also require annual training. For example, there is a legal requirement for people doing asbestos-licenced work to attend annual training. Records of all training undertaken/planned should be maintained.

Key aspects of training for site managers and engineers should include:



- asbestos
- pollution prevention
- resource management (materials, water, energy, and waste) and sustainable use of resources
- waste duty of care
- ecology and archaeology awareness
- emergency procedures for environmental incidents.
- choice of plant, plant maintenance and safe refuelling
- permits/licences/consents management and monitoring requirements
- choice of working methods
- data collection and record keeping (eg to demonstrate compliance with relevant legislation, planning conditions and contract requirements)
- sources of advice and help
- personal responsibility/liability.

All site staff should have a site induction, which should include site-specific environmental risks and their control and management. Further training, such as spill kit use, should be given to all relevant staff. Use notice boards in communal areas to remind staff about key environmental issues, for example related to the programme stages (**Figure 2.2**).



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2.6 ENVIRONMENTAL MANAGEMENT SYSTEMS (EMS)

An EMS is a systematic approach to assessing, managing and monitoring environmental impacts. This includes the definition of management responsibilities and development of documented procedures. A systematic approach means all staff are aware of what is expected of them and provides consistency throughout the organisation. The content of the EMS is often translated to the EMP which site staff have to follow.

In the UK, ISO 14001:2015 is the main international standard for EMS. BS 8555:2003 provides guidance on the phased implementation of an EMS to achieve the ISO requirements and, if appropriate, accreditation to the Eco-Management and Audit Scheme. See ISO (2015).



Further information: **https://ec.europa.eu/environment/emas/index_en.htm**

Useful links

CIRIA Training: **www.ciria.org/training**

City and Guilds: **www.cityandguilds.com**

Construction Industry Standards and Training: **https://www.citb.co.uk/standards-and-delivering-training/**

Construction Skills Certification Scheme: **www.cscs.uk.com**

Supply Chain Sustainability School: **www.supplychainschool.co.uk**

Wildlife Trust Biodiversity benchmark:
https://www.wildlifetrusts.org/partnerships/working-businesses/biodiversity-benchmark

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3 Planning, setting up, and managing the site

This chapter outlines measures that should be considered when setting up and planning the site to achieve environmental good practice.

3.1 SITE OFFICES LAYOUT

When planning the site layout, contractors' offices should:

- consider the use of existing building space
- ensure welfare facilities and equipment are located/placed so that pollution and other forms of disturbance to surrounding neighbours are minimised
- be located so as not to cause any adverse environmental impact (eg destruction of ecological habitats). Note that hedges, existing trees and hoarding boards could be used as screens
- consider transport links for deliveries and site staff (see **Section 4.6**)
- consider availability of electrically-powered plant and charging points/spaces.

3.2 SITE MANAGEMENT

Most pollution incidents, environmental damage or other causes of complaints can be avoided through careful planning and good site management.

This includes applying good practice when dealing with:

- materials, equipment and plants (see also **Section 4.5**)
- traffic and access route (see also **Section 4.6**)
- housekeeping, pollution prevention and waste (see also **Sections 4.4 and 4.5.3**)
- working hours
- site security
- site lighting (see **Section 4.4.2**)
- incident response issue
- site demobilisation following completion.

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3.2.1 Materials, equipment, and plant

Good site management will improve resource and site efficiency, and lead to fewer spillage and contamination incidents, and less waste of raw materials. See **Sections 4.3 to 4.5**.

Although no longer a legal requirement, it is still considered good practice to have a RMP or SWMP. It decreases waste generation and site-based staff will be aware of, and plan for, the management, storage and disposal of materials in advance.

3.2.2 Traffic and access routes

Traffic on roads in and around the site can cause nuisance such as noise, exhaust emissions, dust and congestion, and can create a safety hazard both on and off site. These nuisances, and the visual intrusion of queuing vehicles, are a common source of complaint from local residents (see also **Chapter 4**).

3.2.3 Housekeeping and pollution prevention

Housekeeping is an important part of good environmental practice, and it helps everyone to maintain an efficient and safer site (**Figure 3.1**). The site should be tidy, secure, and have clear access routes that are well signposted. Care should be taken to reduce pollution on land, air and water, and waste management (see **Sections 4.3, 4.4 and 4.5.3**).



Figure 3.1 Tidy and organised site (courtesy Mace)

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Good practice checklist

Good housekeeping and pollution prevention	✓
Plan the site with designated areas of materials and waste storage	
Segregate each type of waste as it is produced and arrange frequent removal	
Keep the site tidy and clean – remember a tidy site is a safe site and less likely to cause pollution and accidents (eg trips, slips and falls)	
Ensure that no wind-blown litter or debris leaves the site and use covered skips	
Ensure that material and plant storage areas are responsibly managed. Cover lightweight materials with sheeting if necessary	
Keep hoardings tidy – repair and repaint when necessary, removing any fly posting or graffiti	
Clean wheel washing facilities regularly	
Keep haul routes clean	
Keep roads free from mud by using a road sweeper	
Ensure site is secure from trespass, theft, and extreme weather events	

3.2.4 Working hours

Site working hours can cause concern and annoyance for neighbours. The following aim to help manage these issues:

- On some projects, working hours for noisy operations are defined by the contract documents, planning conditions or by local authorities using a Section 61 consent (these should be confirmed early in the project).
- Try to restrict working to sociable hours. There may be opportunities for extending working hours in consultation with the local authority, but their effect on neighbours need to be carefully considered; it is important to inform neighbours in advance of the reasons for the work and its duration.
- Ensure that activities are carefully timed within the working day. Schedule deliveries outside of rush hour and other intrusive activities at less sensitive times. Constraints will vary from site to site, so it is important to understand the daily patterns of the neighbours.

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Consider the following:

- in city centre sites, night-time noise may be more acceptable than day-time noise if there are no residential areas
- local restaurants may appreciate less disturbance during lunch and dinner times
- local businesses may require quieter periods during the day
- weekend or night-time working may be especially sensitive to the local community
- hospitals, churches, residential care homes, and schools/colleges/universities (particularly during exam periods) are sensitive receptors.

See also **Sections 4.4.3 and 4.6**.

Useful links

England and Wales

UK Gov: **https://www.gov.uk/topic/environmental-management/environmental-permits**

NRW: **https://naturalresources.wales/permits-and-permissions/environmental-permits/?lang=en**

Northern Ireland

Part A and B: **https://www.gov.uk/pollution-prevention-and-control-permit-part-a-and-b-northern-ireland**

DAERA: **https://www.daera-ni.gov.uk/articles/ippc-guidance-and-application-forms**

Scotland

SEPA Environmental Authorisations (Scotland) Regulations 2018: **https://www.sepa.org.uk/regulations/how-we-regulate/environmental-authorisations-scotland-regulations-2018/**

3.2.5 Site security

Many environmental offences are based on strict liability, with little or no defence available. Contractors can be held liable for environmental damage even when caused by vandals. A secured site will:

- ensure the safety of the community, particularly children
- reduce vandalism
- reduce adverse environmental impacts caused by vandals, such as:
  - opening taps on tanks containing fuel, or cutting fuel lines

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- tipping out other liquids from drums and containers
- damaging/stealing raw materials and other construction work in progress
- playing on plant – damaging it and using it to cause damage
- spraying graffiti or fly posting on site hoardings
- setting materials/waste on fire

Rural areas, which often have fewer residents, may be more vulnerable to vandalism and especially theft. Security staff providing a visible presence in these locations can be as important as those in an urban setting.

Good practice checklist

Security measures	✓
Site boundary	
Secure the site boundary using perimeter fencing and high-quality locks on gates. Solid barriers (eg hoardings) are more difficult to scale than chain-link or wooden fences and prevent casual surveillance by prospective thieves and trespassing	
Do not stack materials against the inside or outside of a site boundary/ fence as this can provide an opportunity for vandals and thieves to scale it	
Position fuel tanks, hazardous materials, and waste away from the site boundary to deter theft and arson	
***On* site**	
Move valuable items and those prone to theft away from public view. Store these goods in a locked container or storage area	
Ensure that potentially hazardous materials are well-secured and, where possible, located away from watercourses	
Secure and immobilise plant and equipment overnight to prevent vandalism	
If the site is large or at considerable risk from trespassers install deterrents such as lights, warning notices, 24-hour security guards, alarm systems and closed-circuit television (CCTV) (see also 'site boundary' above)	
Monitor movement of people on and off site by using site passes or swipe	
Position the site manager's office so that it has a good view of the site	
Inform local police about the site and ask for their advice on security	

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Security measures	✓
Contact the Fire Service for advice on storing fuel and flammable materials on site	
If an incident, such as vandalism, occurs on site ensure that appropriate clean-up/repair is undertaken promptly to avoid further issues	

3.2.6 Lighting

For construction sites to work effectively and safely, it is important that the site is well lit, either by natural or artificial lighting. Appropriate lighting levels on construction sites are important so that site workers can carry out their duties effectively and safely. Ensure that the site is well lit – but note that too much light can cause accidents on site (see also **Section 4.4.2**).

3.2.7 Incident response issue

3.2.7.1 Pollution incident response plan

The likelihood of an incident can be minimised by effective planning such as developing a site pollution incident response plan. The plan needs to identify the on-site risks and appropriate responses. An effective plan relies on the following elements:

- identification of all emergency scenarios
- identification of receptors/pathways (eg surface water drains/river)
- describe the appropriate incident response procedures which should also include, for example, availability of booms and spills kits at appropriate locations
- identification and dissemination of contact details such as:
  - list of site staff and subcontractor offices
  - the company's environmental representative
  - Fire Service/Police (999)
  - environmental regulator (EA, SEPA, NRW, NIEA)
  - spill clean-up contractors
  - local authority environmental health department
  - sewerage provider
  - equipment suppliers (skip hire for waste disposal)

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- waste disposal contractors
- local residents, the public and neighbouring businesses that could be affected.

- definition of site staff responsibilities, ie who will:
  - take charge at the scene
  - report to the site manager/environmental advisor
  - report to the appropriate environmental regulators (EA, SEPA, NRW, NIEA)
  - record events as an incident record
  - regularly check the contents of the spill kits are fully stocked. Used or missing spill kits should be replaced at the earliest opportunity.
  - communicate with the media
- provision of appropriate training for site staff including incident scenarios practice, ie spill drills
- implement lessons learnt from previous incidents.

An incident response procedure should be based around the principle of:

STOP CONTAIN NOTIFY CLEAN-UP INVESTIGATE

If a major spill takes place, site staff should immediately notify the appropriate environmental regulator. It is always good practice to inform the regulator of the incident if in any doubt of the potential damage caused by a spill.



Incident Hotlines

In England, Scotland, and Northern Ireland (24-hour service): **0800 80 70 60**

In Wales (24-hour service): **0300 065 3000**

Polluting wash off water should not be discharged to land, groundwater or surface water (see Section 4.5.4).



3.2.7.2 Spill kits

Spill kits are equipment that can contain and/or absorb spills on land and water. Obtain them from a reputable supplier and make sure they are specific to the oils and chemicals that are on site.

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At the start of the project, it is important the kit that is appropriate to the type of spill expected can be accessed and deployed easily when needed. The contents of the kit will depend on the project and should be inspected daily, but are likely to include:

- absorbent granules, pads, and socks
- string
- floating booms
- PPE, ie gloves, goggles, and overalls
- drain covers/blockers
- polythene sheeting and bags.



Figure 3.2 Small spill kit and spill control site (courtesy BAM Nuttall)

Universal/maintenance spill kit materials are used for a wide range of liquids such as oils, coolants, paints, solvents, diesel, and mild acids and alkalis. There are also many types of spill kits and materials that can be used to manage particular types of pollutants (see **Table 3.1**).

Top tips when selecting the spill kit/materials include:

- Ensure that the spill kit/materials are appropriate for the substance.
- Socks are particularly useful for forming a ring around spills and act as an absorbent barrier to soak up spills.
- Pads and rolls are used to absorb spilt liquids and can be used on land or water. Pads can be placed into drip trays to catch leaks/drips from machinery.
- Marine booms are much larger barriers than socks and there are several types. Oil booms can be linked to provide containment, and some are also absorbent. Fence booms can be used to capture silt and wet concrete spills.
- Cushions have great absorption capacity. They are particularly useful where there is the greatest concentration of spill. Cushions can be placed into drip trays to catch leaks/drips from machinery.

See **Section 4.5.3**.

Spill kits should be stored in a marked bag or wheelie bin in a well-signposted location and protected to prevent damage from the weather. It is best to store them near to where they may be needed. Ensure that if materials from the spill kit are used that they are replaced immediately. Some equipment may need to be disposed as hazardous waste.

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Table 3.1 Pollutants from spillage on site and spill kit/material

Pollutant on site or spilt	*Oil only*	*Oil and water*	*Concrete/cement/ Bentonite*	*Aggressive chemicals*	*Less aggressive chemicals (eg solvents)*	*Silt*	*Acids/alkalis*
Type of spill kit/materials							
Universal/maintenance spill materials (eg sawdust, granules)	Y	N	N	N	Y	N	N
Hydrocarbon/oil only sorbents (eg pads, booms, pillows)	Y	Y	N	N	N	N	N
Chemical spills materials	Y	N	N	Y	Y	N	Y
Neutralisers	N	N	N	Y	N	N	Y
Bioremediation agents	Y	Y	N	N	Y	N	N
Surface cleaners/degreasers	Y	Y	N	N	N	N	N
Sand	Y	Y	N	N	N	N	N
Absorbent granules (should be suitable for the substances)	Y	N	N	N	Y	N	Y
Drip trays (made of material suitable for substances to be contained)	Y	Y	N	Y	Y	N	Y
Plant nappies	Y	Y	N	N	N	N	N
Reusable drain seals	Y	Y	Y	N	Y	Y	N
Bentonite drain seals	Y	Y	Y	Y	Y	Y	Y
Oil booms	Y	Y	N	N	N	N	N
Fence booms	N	Y	Y	N	N	Y	N
Geotextile fence	N	N	Y	N	N	Y	N
Straw bales	N	N	Y	N	N	Y	N

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3.2.8 Site demobilisation following completion

Following site demobilisation, site staff are often required to remove the following items:

- plant
- surplus materials
- waste and skips
- rubbish and litter
- residues
- signage
- cabins
- temporary works including ecological measures, eg traps, nets.

When clearing the site it is vital that wastes are managed in accordance with the legislation including avoiding burning of any clearance materials.

Materials removed during the site demobilisation are still subject to transport management plans, loading procedures, waste management regulations etc. This includes unused materials stored or taken to another site. See **Section 4.5.3**.

Further reading

NETREGS Guidance for pollution prevention (GPP) documents:

GPP 1 *Understanding your environmental responsibilities – good environmental practices*

GPP 2 *Above ground oil storage tanks Treatment and disposal of wastewater where there is no connection to the public foul sewer*

GPP4 *Treatment and disposal of wastewater where there is no connection to the public foul sewer*

GPP5 *Works and maintenance in or near water*

GPP 8 *Safe storage and disposal of used oils*

GPP13 *Vehicle washing and cleaning*

GPP 20 *Dewatering underground ducts and chambers*

GPP21 *Pollution incident response planning*

GPP22 *Dealing with spills*

https://www.netregs.org.uk/environmental-topics/guidance-for-pollution-prevention-gpp-documents/

Environment Agency (2021): *Environmental permits: detailed information*:
https://www.gov.uk/topic/environmental-management/environmental-permits

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4 Environmental issues

4.1 ECOLOGY, PROTECTED SPECIES, HABITAT AND BIODIVERSITY

4.1.1 Why this is important

Ecology is the study of wildlife (plants and animals) and their relationships to, and interactions with, each other within the physical environment. 'Habitat' refers to the characteristics of the natural home where animals (ie mammals, birds, fish, reptiles, amphibians, and insects) and plants live.

> "Without a wide range of animals, plants and microorganisms, we cannot have the healthy ecosystems that we rely on to provide us with the air we breathe and the food we eat"
>
> (The Royal Society, n.d.).

Biodiversity describes the wide variety of living organisms in a particular geographic area (ecosystem).

The world is witnessing a colossal decline in global biodiversity. The UK is one of the most nature-depleted countries in the world and 15% of UK species are threatened with extinction. Of the G7 countries, the UK has the lowest level of biodiversity remaining (House of Commons, 2021).

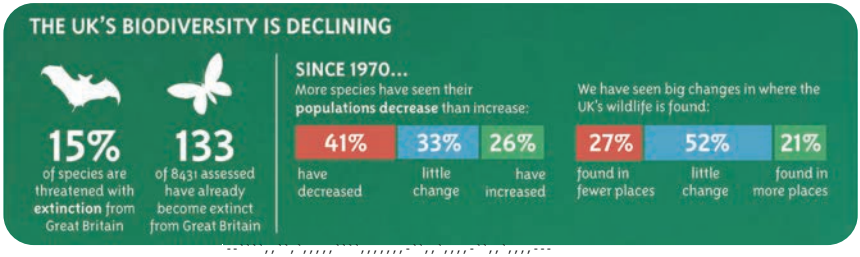


Figure 4.1 The UK's declining biodiversity (from NBN, 2019)

Habitats are usually naturally formed (eg a tree), but they can be artificial (eg a railway embankment) or formed through habitat creation (ie translocation).

Other types of habitats include coastal and marine, freshwater, heathland, and soil.

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4.1.1.1 Potential impact of construction activities

Ecology may be affected by construction activities in two ways:

1 **Direct effects** on the ecology at the site, for example pollution of a watercourse on site, removal of habitat, and killing of individual flora or fauna.

2 **Indirect effects** because of construction processes/activities, for example deforestation of timber materials, downstream water pollution of a habitat, or poor biosecurity measures allowing the introduction of non-natives species.

Damage to trees and hedgerows may be caused either through **direct** physical injury to the branches, trunk, or roots, or **indirectly** by changing the soil or water character around the roots. This can arise from various actions including compaction (even one piece of machinery going over the root protection area can cause damage), raising soil levels, impervious covering around roots, and changing the water table.

See also **Section 4.1.4.3**.

Construction activities should be carefully planned and managed to minimise negative ecological impact and increase biodiversity. This is because of:

- The need to meet planning conditions. Under the Environment Act 2021, achieving at least 10% biodiversity net gain will be a new planning condition to all planning permissions in England (with a few exemptions) from November 2023 onwards.
- Fines and even imprisonment for non-compliance with legal obligations (eg to safeguard protected species and avoid the spread of non-native invasive species).
- Client-led obligations and contract conditions (eg social value in public procurement contracts) may apply, many procurements now seek to deliver public sector agenda/corporate social responsibility commitments and avoid damaging publi relations (PR) exposure.
- Misunderstanding ecological constraints can lead to significant programme delays and increase costs (due to the seasonality of both surveys and any mitigation works).

4.1.1.2 Human health risks and ecology

Noxious plants can pose a risk to human or environmental health because of the chemicals they contain. For example, Giant hogweed (*Heracleum mantegazzianum*) has phytotoxic sap which can burn and irritate the skin.

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4.1.2 Good practice checklist

On-site works	✓
Before construction	
Check if wildlife has been considered. As a minimum a Phase 1 habitat survey should have been carried out, and surveys to investigate for the presence of specific species	
Check if there are any ecology, protected species, habitat, and biodiversity related pre-construction surveys or early works mitigation required before works can begin on site	
Are there any BNG requirements on site, which include maintaining and improving existing biodiversity? If yes, has a pre- and post-construction BNG baseline been prepared? If habitats are to be retained and protected during construction, have these been identified and communicated to site staff?	
Check whether there are planning conditions that apply to ecology, protected species, habitat, and biodiversity (eg additional surveys, protection of species, and/or Tree Preservation Orders (TPOs), translocation and monitoring)	
Check whether there are any contract requirements that are relevant to ecology, protected species, habitat, and biodiversity	
Check whether any local biosecurity measures are in place	
Check that the site induction and toolbox training cover the relevant ecology, protected species, habitat, and biodiversity issues expected	
Check if a professional ecologist has been, or will need to be, appointed to support the construction stage of the project	
Consult a site ecologist before any works to mitigate or translocate species are undertaken	
During construction	
Protected species	
If found on site, or suspected to be on site, stop work and follow the agreed processes to manage them	
Seek expert advice about how to manage the protected species and related site activities	
Invasive non-native species	
If found, or suspected to be on site, follow the agreed processes to manage them	

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On-site works	✓
Seek expert advice about how to manage the invasive non-native species and related the site activities	
Noxious species	
If found, or suspected to be on site, follow the agreed processes to manage them	
Seek expert advice about how to manage the noxious species and related site activities	
Staff should use personal protective equipment (PPE) to manage these plants as the sap can burn and irritate the skin	
Working near water	
Place a protective bund around ponds to prevent water pollution affecting wildlife	
Consider monitoring water levels during the works to find out if dewatering has affected the groundwater – this can have an impact on the ecology of wetlands around the site	
Put mitigation measures in place, for example silt fencing to protect water quality so that wildlife will not be affected	
Avoiding damage to trees and hedgerows	
Check whether a felling licence is required and whether any trees on site are covered by a TPO; liaise with the local authority in England Wales and Scotland (and local planning office in Northern Ireland) if needed	
Consider the presence of protected species (eg bats, breeding birds, invertebrates) and seek expert advice if needed	
Protect trees, which are often habitats for bats and nesting birds, within or near to the working area from nuisance (ie noise and light pollution). Avoid accidental disturbance of nesting birds – do not fell or clear any trees or shrubs between March and August – but beware that certain species may breed outside these months	
Put up temporary fencing around trees and hedgerows that need to be protected	
Avoid root protection zones (this should be stated in the EMP)	
Do not work on tree protection zones without consent	

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On-site works	✓
Do not store spoil or building materials within root protection zone or under tree canopy	
Avoid damaging bark or branches	
Keep vehicles and plant away from trees and hedgerows	
Do not cut or damage any roots >25 mm in diameter within the tree protection zone	
Cut roots only with a clean hand saw – not a spade or mechanical digger	
Wrap damp sacking around any exposed roots until ready for backfilling	
Backfill holes with care to ensure that roots are not damaged and compact backfill lightly	
Keep toxic materials, such as diesel and cement, away from trees and hedgerows	
Before leaving site	
Check that pitfall traps used for catching reptiles and amphibians to protect them during works have been decommissioned and removed	
Check that netting and any other barriers used to temporarily control wildlife during construction works have been removed	

4.1.3 Statutory Nature Conservation Organisations

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In the UK, the conservation of wildlife and natural features is the responsibility of the Statutory Nature Conservation Organisations (SNCO), see **Box 4.1**.

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Box 4.1 Statutory Nature Conservation Organisations – contact information

Natural England
https://www.gov.uk/government/organisations/natural-england
0300 060 3900

Natural Resources Wales
https://naturalresources.wales/?lang=en
0300 065 3000

Northern Ireland Environment Agency
https://www.daera-ni.gov.uk/northern-ireland-environment-agency
0300 200 7856

Nature Scot
www.nature.scot/
01463 725 000

The remit of the SNCO includes providing ecological advice (such as consultation during planning), promoting biodiversity, conserving designated ecological, geological, and geomorphological sites, and protecting species. While SNCO are responsible for enforcing compliance the police take the lead when investigating offences and wildlife crime.

There are also non-governmental organisations (NGO) that have a remit to conserve wildlife. These include Wildlife Trusts, and special interest groups such as badger, bat, and bird societies (eg the Royal Society for the Protection of Birds [RSPB], and the Bat Conservation Trust [BCT]) and local wildlife groups. These organisations can provide valuable information and guidance to the site managers.

4.1.4 Legal and regulatory requirements

4.1.4.1 Managing protected species

Capturing, killing, or disturbing protected species or damaging/destroying the places where they live, whether deliberately or accidentally can result in prosecution under a range of legislation. The fine for noncompliance varies according to the species, the habitat, and the type of damage caused (see **Box 4.2**). The UK National Wildlife Crime Unit provides information and contact details on wildlife crime: **https://www.nwcu.police.uk**

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Box 4.2 Developer fined for destroying bat habitat (from BBC, 2020)

In December 2020 a building company was ordered to pay a £600 000 fine plus £31 000 in costs for destroying a bat habitat at a construction site in East London. It was found that demolition works were undertaken without the necessary mitigation and licences being in place despite the presence of soprano pipistrelle bats (a European Protected Species) was documented at the site in 2017.

Some of the important protected species (**Figure 4.2**) that may be encountered in construction projects across the UK are:

- Mammals
  - badger
  - bats
  - dormice
  - water voles
- Reptiles
  - adder
  - sand lizard
  - smooth snake
  - common lizard
  - grass snake
  - slow worm
- Amphibians
  - toads
  - newts
- All nesting birds

Other UK protected species include red squirrel, pine marten, wildcat, otter, some fish species, marine mammals, invertebrates, and plant species.



Figure 4.2 UK protected species, slow worm (a) and nightjar (b) (courtesy Arcadis)

To obtain a full list of nationally protected species under legislation for England and Wales refer to Schedules 5 and 8 of Wildlife and Countryside Act 1981 (as amended) and for Northern Ireland refer to Schedules 5 and 8 The Wildlife (Northern Ireland) Order 1985 (as amended). In Scotland, NatureScot (2022) provides a table of protected species and the legislation under which each is protected. For general guidance on dealing with protected species on site see Newton *et al* (2011).

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Many animals and plants are protected throughout or for part of the year by legislation. Work may have to be adapted or delayed until such a time that it will not cause adverse effect to the wildlife or the places where they live. Where planned activities could affect protected species or habitats, this work may be subjected to licences issued by the SNCOs. Planning permission is usually required before an application for such licence.

Note that the time for different SNCOs to review licence applications may vary.

Some notable species need specific attention when implementing mitigation measures. For example, foxes are protected under legislation and fox earths should not be destroyed until it is certain they are unoccupied. In these cases ecological advice should always be sought.

If it is suspected that any protected animal may be affected by the site works stop and seek specialist advice before continuing.



To learn more about protected species, CIRIA provides a series of wildlife toolbox talks: **https://www.ciria.org/CIRIA/Resources/Toolbox_talks**

4.1.4.2 Designated sites

Designated sites have important ecological attributes or natural landforms. They are given special protection at the regional, national, or international level according to their importance or rarity. The level of legal protection, restricted activities and penalties for offences also depends upon the designation, the ecological sensitivity, and the offence.

Examples of designated sites (in alphabetical order) are:

- Area of Outstanding Natural Beauty (AONB)
- Area of Special Scientific Interest (ASSI) (Northern Ireland)
- County Wildlife Sites (CWS)
- Local Nature Reserve (LNR)
- National Nature Reserve (NNR)
- National Scenic Area (Scotland)
- RAMSAR site (Convention on Wetlands of International Importance)
- Regionally Important Geological Sites (RIGS)

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- Special Area of Conservation (SAC)
- Special Protection Area (SPA)
- Site of Importance for Nature Conservation (SINC)
- Site of Local Importance for Nature Conservation (SLINC)
- Site of Local Nature Conservation Importance (SLNCI)
- Site of Nature Conservation Interest (SNCI)
- Site of Special Scientific Interest (SSSI)
- World Heritage Sites (WHS).

It is an offence to carry out works on a designated site without the permission of the relevant nature conservation body, ie SNCO. Always contact the nature conservation body for further guidance on designated sites. Often several months' notice is required before works begin. It is important to adhere to working methods once they have been agreed with the appropriate SNCO.



4.1.4.3 Natural features (trees, hedgerows, rock, and landforms)

Trees

Contract or planning conditions may state that certain trees must remain undamaged. These trees may be subjected to a TPO, be within a conservation area, or be related to a former planning permission. A TPO protects a single tree, group of trees or woodland, while all trees in a conservation area are protected.

A TPO prohibits:

- cutting down
- topping
- lopping
- uprooting
- wilful damage
- wilful destruction
- cutting roots.

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Tree felling is a legally controlled activity. If >5 m^3 of tree is to be felled, a felling licence may be required, Replacing damaged mature trees can be expensive – a 10 m high tree may cost £2000, plus extra expense for delivery, planting, and several years' maintenance.

In June 2023 a man was arrested for felling 131 trees in a parkland area to give way to a sports facility, however he had not been granted permission from the local council and despite being granted a lease. If found guilty of committing an offence, which contravenes Section 210 of the Town and Country Planning Act 1990, he could be fined up to £20 000 at a Magistrates Court or an unlimited fine at Crown Court.

https://www.standard.co.uk/news/london/bromley-tree-massacre-cator-park-131-trees-felled-london-b1087779.html

If trees are likely to be damaged, moved or removed in a project, the following should be in place **before** work begins:

- The local authority has been contacted and they have decided if a provisional TPO is needed.
- If permission to work on a tree(s) with a TPO is needed, the form obtained from the local authority outlining the intended work has been completed and returned. **Note that the local authority then has up to two months to decide. During this time local residents can appeal against the work.**
- Consideration have been given to protected species (eg bats, breeding birds, invertebrates) as well as plants (eg lichens, mosses) that may be supported by the tree(s) and expert advice sought.

BS 5837:2012 provides guidance on protecting trees during construction.

Hedgerow

Hedgerows in England and Wales are protected under legislation and there is a requirement to notify the LPA where the hedgerow is situated. The removal of any hedge longer than 20 m requires planning permission. If the hedge is shown to be significant in terms of its age, or environmental or historical importance, then the LPA can refuse such permission (after a six-week determination period) and take further measures to protect the hedgerow.

Rocks and landforms

Some rock exposures and landforms will be SSSIs/ASSIs, but others may be regionally and locally important; if in any doubt as to their significance or how to protect them contact the SNCO.

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4.1.4.4 Invasive non-native species

Invasive non-native species (INNS) are those plants and animals, both terrestrial and aquatic that are not native to the UK and have been introduced into the environment, either deliberately or accidentally, by human activity (**Figure 4.3**).

Examples of invasive plant species include Japanese knotweed (*Fallopia japonica*), Giant hogweed (*Heracleum mantegazzianum*) and Himalayan balsam (*Impatiens glandulifera*).

Non-native species are listed on the Wildlife and Countryside Act 1981 as amended for England and Wales. Similarly, Northern Ireland's legislation has an equivalent list of non-native plant and animal species that are banned from being released, planted, or otherwise grown in the wild (see The Wildlife (Northern Ireland) Order 1985). There is no species list for Scotland due to amendments in the Wildlife and Countryside Act 1981.

It is illegal to release into the wild any animal, plant, or micro-organisms not ordinarily resident to the UK or which constitutes a known threat. In Scotland, it is an offence to *"plant, or otherwise cause to grow, a plant in the wild at a location outside its native range"*.

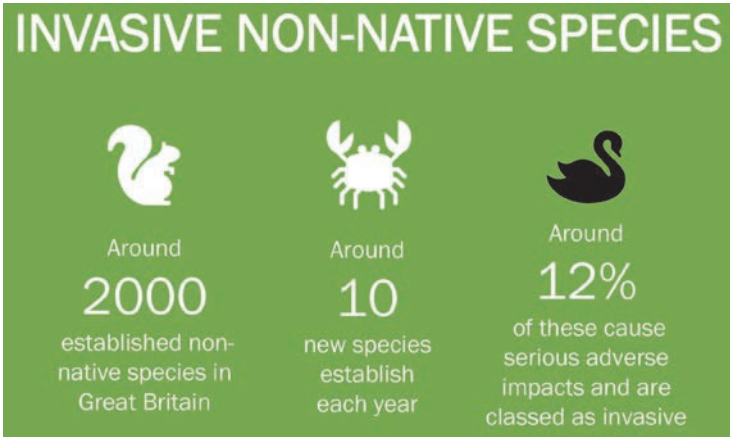


Figure 4.3 Invasive non-native species

Ecology is adversely affected through the spreading of invasive species. Often INNS out-compete or displace native species and can carry diseases that affect them due to lack of natural controls. For example, the grey squirrel (which is a non-native species) can carry squirrel pox virus that does not affect them but can kill the native red squirrel.

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Further information and guidance on the identification and management of non-native invasive species is available from the GB Non-native Species Secretariat (NNSS) and the Invasive Species Northern Ireland (**Figure 4.4**). The Scottish Government (2012) have published a code of practice which *"provides guidance on how you should act responsibly within the law to ensure that non-native species under your ownership, care and management do not cause harm to our environment".*

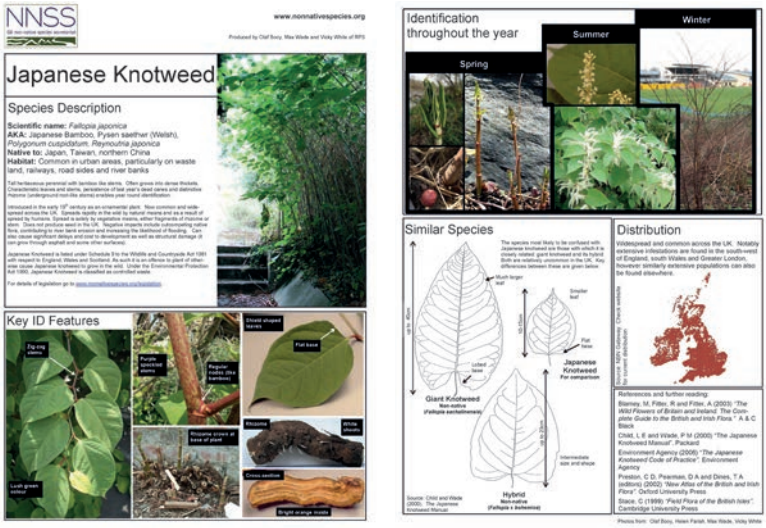


Figure 4.4 Example ID sheet for Japanese knotweed (from GB NNSS, 2022)

Biosecurity comprises measures, some of which are imposed by legislation, to prevent the spread of harmful organisms such as plant pests, pathogens and some bacteria and fungi as well as invasive species. Movement of these organisms between or within countries can be via:

- plants
- soil and organic materials
- timber and wood packaging
- air-born or water-born natural migration
- dirty equipment and machinery used across different locations.

Construction projects, via site activities, should identify biosecurity risks and apply relevant biosecurity mitigation measures.

For more information, including applicable legislation, pest and disease alerts, and factsheets, see Defra's UK Plant Health Information Portal: **https://planthealthportal.defra.gov.uk/**

GB NNSS website: **https://www.nonnativespecies.org/what-can-i-do/check-clean-dry/#**

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4.1.5 Before site work begins

To avoid unexpected delays and costs during construction it is important to:

- organise works so that ecological issues are dealt with appropriately, legally, in line with good practice, cost effectively, and at the right time of year
- identify biosecurity risks and consider INNS
- consult professional ecologists early in the project and have an ecologist holding an appropriate survey licence to undertake surveys.

A responsible attitude should be adopted to ensure construction activities cause the least damage to the surrounding natural environment and to consider the biodiversity mitigation hierarchy (**Figure 4.5**), at an early stage.

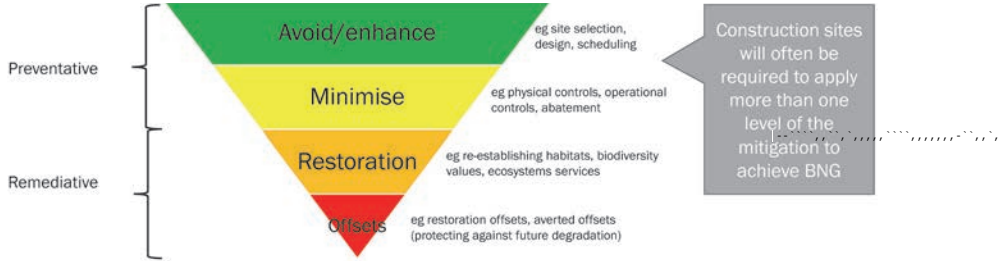


Figure 4.5 Biodiversity mitigation hierarchy (after Ekstrom et al, 2015)

Where possible, always look for opportunities to enhance the natural environment on site, for example building green infrastructure, bat roosts, and wildlife crossings and corridors. The insect and invertebrate hotels illustrated in **Figure 4.6** are examples of simple biodiversity enhancements.

Having a dedicated professional ecologist available through all stages of the project will help secure better outcomes.

Getting the local community involved with ecological initiatives improves relations and can reduce negativity and hostility to a development from neighbouring properties.

Before starting work on site it is important that all ecological constraints and obligations, as well as the relevant legal requirements, are understood. Surveys identifying wildlife should have been conducted at the planning stage (see **Box 4.3**). All direct and indirect impacts should be assessed and mitigated.

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Figure 4.6 Insect (a) and invertebrate (b) hotels (courtesy Arcadis)

Box 4.3 Survey and biodiversity benchmarking

Ecological surveys and biodiversity benchmarking are often required for a project to receive planning permission. If planning permission has been granted, legislation, planning conditions or the age of the original survey may mean that further surveys are still needed. For example, to:

- assess the impacts on specially protected species and/or habitats
- obtain licences to work with or disturb species and/or habitats.

Reports are only valid for a limited time. A project may be delayed while waiting for the correct time of year to undertake a wildlife survey of the site and/or for a licence to be applied and granted – early establishment of programme restrictions is advisable (**Figure 4.4**).

An advice note published by CIEEM (2019) provides more information.

CIRIA's BIG Biodiversity Challenge invites the construction industry to add a new biodiversity enhancement to construction projects.

The Challenge showcases both simple and more complex multiple interventions that can be useful on site.

For more information: **https://www.bigchallenge.info/**

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Survey period	January	February	March	April	May	June
 ***Dormice*** Surveys: May to October						
 ***Bats*** Roost surveys: May to September						
 ***Reptiles*** Surveys: April to September						
 ***Great crested newts*** Pond surveys: March to June						
 ***Breeding birds*** Surveys: March to August						
 ***Otters*** Surveys: all year, when water levels are low						
 ***Water voles*** Surveys: March to October						
 ***Badgers*** Surveys: March to September						

Figure 4.7 Protected species survey calendar (after Newton et al 2011)

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	July	August	September	October	November	December	
							Dormice are orangey-brown with a white belly and furry tail. They are nocturnal and live in woodland and hedges
							Bats are found in rural and urban areas and use different roosting places for resting, breeding and hibernating
							There are six species of reptile in the UK (common lizards, sand lizards, slow worms, adders, grass snakes and smooth snakes)
							All newts are amphibians and great crested newts have bright orangey-yellow bellies with black spots
							Birds, including rare species, may be found breeding on construction sites. Nesting sites should only be inspected by experienced ecologists and work should stop in the immediate area
							Otters live along watercourses and occur in both rural and urban areas, including major cities
							Water voles have chestnut brown fur, a round face and a short fury tail. They are found in slow-flowing rivers, ditches, dikes and around lakes and ponds with steep banks and vegetation
							Badgers are up to a metre long and live in groups in underground setts. They are nocturnal and leave well-worn paths, dungpits and scratching posts in their territories

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- Information collected, ecological reports prepared, and documentation submitted to the local authority should be passed to the contractor. This should identify ecological receptors, programme constraints, requirement for additional surveys, and any mitigation measures.

  If no recommendations/mitigation measures are provided, seek advice from the environmental advisor or the person assigned with environmental responsibility in the site environmental plan, such as the Ecological Clerk of Works (ECoW), or seek guidance from an experienced ecologist.
- Check whether any biosecurity measures should apply to the works.
- When designing the construction programme, avoid disturbance to species at particularly sensitive times, such as during hibernation, mating, and nesting seasons. Always allow sufficient time to identify ecological risks and for mitigation.
- Identify and securely fence off any sensitive habitats (**Figures 4.8 and 4.9**) and restrict the movement of workers to designated areas. For many categories of wildlife, for example nesting birds and roosting bats, the timing of work will be important, so correct scheduling may avoid issues. Liaise with the SNCOs and with third parties such as local environmental/ wildlife groups for advice.
- Take care to avoid unintended consequences when managing wildlife. For example, netting of trees, hedges, and bushes to prevent nesting birds can result in other animals becoming trapped. The RSPB recommends that netting:
  - should not be seen as the 'easy' option
  - should only be used under the supervision of a trained ecologist
  - should be checked at least once (and ideally three times) a day to make sure wildlife is not trapped.



Figure 4.8 Wildlife barriers (courtesy Skanska)



Figure 4.9 Badger exclusion zone (courtesy Arcadis)

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- Dust, light, noise, and vibration can affect wildlife; care needs to be taken when designing mitigation measures (see also **Sections 4.4.1 to 4.4.3**)
- The EMP should include measures to ensure legally compliant good management of ecology, and any impacts on biodiversity and habitats. This includes monitoring and inspection and emergency protocols for unexpected incidents such as pollution and extreme weather events (see BS 42020:2013).
- Be aware that consultations and negotiations can cause delays to the programme. Opportunities for mitigation may be limited when the design is fixed, and works have begun.
- Communicate any areas of concern, methods of working, and licence/consent conditions to site staff. Ensure that all site workers understand when they may need to stop work if they encounter unexpected ecological conditions.
- Before work begins site staff should:
  - attend a site induction where they would be informed of any ecological constraints and provided with basic knowledge of wildlife on site
  - be aware of any special working methods they would need to follow to protect sensitive species, habitats or maintain BNG areas, and any areas or features that traffic movements, materials storage or other impacts from the site should avoid
  - be advised of any biosecurity measures relating to overseas procurement/certification of UK origin, INNS, or local restrictions, eg foot and mouth disease
  - be advised of the presence of any noxious plants or invasive plant species, their treatment and disposal processes. Note that PPE should be provided to prevent skin contact
  - know who to contact with any ecological concerns.

Translocation is considered a last resort. It only occurs when habitat damage is anticipated and unavoidable, and the species concerned can be moved off the site and reinstated in suitable habitat elsewhere. Where translocation is required, this is done by specialists within specific time periods, and typically forms part of the site preparation works. Both aftercare and monitoring of translocated species are essential. Without planning and consideration, translocation may become an expensive process.

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CIRIA provides:

- **In-person** and **virtual training** to accompany this site guide: **www.ciria.org/training**
- Wildlife and environmental **toolbox talks** are a useful source of reference: **https://www.ciria.org/toolbox-talks**
- The Working with Wildlife app provides support for identifying protected: **https://www.ciria.org/CIRIA/Books/Free_publications/Working_with_Wildlife_app.aspx**



The GB NNSS provides ID sheets to identify non-native species: **https://www.nonnativespecies.org/non-native-species/id-sheets/**

4.1.6 During construction

Where particular working practices are required to protect ecological features follow mitigation recommendations and adopt methods of working that are legally compliant. If in doubt or if there are no recommendations contact the environmental advisor or the person assigned with environmental responsibility in the site environmental plan, such as the ECoW, or an appointed professional ecologist.

4.1.6.1 Monitoring

Carry out monitoring before or during construction as required, including ecological reports, surveys, and by checking planning and licence conditions. Ensure that the monitoring process includes action to be taken in the event of an issue arising, ie the expected mitigation measures are failing to deliver the expected outcomes.

4.1.6.2 Unexpected discovery

If there are signs or other indication that wildlife is harmed or injured, or protected species or INNS are suspected or found unexpectedly, work must stop and the site manager must obtain expert advice on how to proceed immediately (see **Box 4.4**).

Consultation with the SNCOs may have to take place to discuss the best way to continue/repair any damage caused to their habitat. Such consultations and

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negotiations can cause delays to the programme and will be at the construction company's cost.

Box 4.4 Warning signs of issues on site

Planning ahead and seeking ecological advice early can minimise issues arising. However, always look out for signs that indicate if there are serious issues on site, for example:

- bats or other nocturnal animals being seen during daylight hours or found on the ground near to the site (**Figure 4.10**)
- injured birds, smashed eggs, young unaccompanied fledglings
- dead fish floating in watercourses affected by works.



Figure 4.10 Pipistrelle bat

4.1.6.3 Managing invasive plants and animals when found on site

In England and Wales 'non-widely spread' listed invasive alien animals must be reported to the NNSS if found on site:

- UK Gov: **https://www.gov.uk/guidance/invasive-non-native-alien-animal-species-rules-in-england-and-wales#non-spread**
- GB NNSS: **https://www.nonnativespecies.org/**

If a widely spread animal is found no action has to be taken although this can be reported along with any plant INNS sightings in England, Wales or Scotland to GB NNSS.

For Northern Ireland reporting is through CEDaR: **http://www2.habitas.org.uk/records/ISI**

For pest/disease reporting:

- England and Wales APHA Plant Health and Seeds Inspector: **planthealth.info@apha.gov.uk**
- Scotland Horticulture Unit: **hort.marketing@gov.scot**
- Northern Ireland DAERA Plant Health Inspection Branch: **planthealth@daera-ni.gov.uk**

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Invasive plants and importance of biosecurity

If noxious or invasive plants or evidence of plant pests/disease are found on site, the site manager should:

- cordon off the area to prevent any inadvertent spreading (see **Figure 4.11**)
- notify the relevant authority that the plant or pest/disease is present
- ensure any vehicles that have entered the site, or PPE that has been used by staff in the affected area, are thoroughly washed (and, in the case of disease, disinfected) before leaving the area of the site where the plant pest/disease is located
- water/disinfectant used to clean vehicles should be controlled (ie contained and disposed of appropriately) to prevent the spread of the plant (through seeds, rhizomes, fragments etc) or polluting the water environment in runoff
- seek specialist and/or regulator advice on effective and appropriate treatment and disposal of the affected material to prevent spreading of the invasive plant.



Figure 4.11 Japanese knotweed signage (courtesy Kier)

Invasive animals and the importance of biosecurity

If invasive non-native animals are found, they should be reported to the relevant monitoring authority, such as the species secretariat. Any waders, pond nets, mobile pumps, and other equipment etc, which may have been in contact with contaminated water, should be thoroughly washed, disinfected (where known pests and pathogens are present) and dried. See Defra (2022a).

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Follow specialist advice and seek approval from the environmental regulator for the proposed control methods.

Further reading

FC (2020) *Tree felling. Getting permission*, Forestry Commission, Bristol, UK
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/876642/Tree_Felling_-_Getting_Permission_-_web_version.pdf

FC and APHA (2021) *Guidance. How biosecurity can prevent the introduction and spread of tree pests, Keep it Clean*, Forestry Commission and Animal and Plant Health Agency, London, UK
https://www.gov.uk/guidance/prevent-the-introduction-and-spread-of-tree-pests-and-diseases

GB-NNSS *Biodiversity*:
https://www.nonnativespecies.org/biosecurity/

SEPA (n.d.) *Biosecurity and management of invasive non-native species for construction sites and controlled activities*, Scottish Environment Protection Agency, Edinburgh, Scotland
https://www.sepa.org.uk/media/163480/biosecurity-and-management-of-invasive-non-native-species-construction-sites.pdf

SEPA (n.d.) *Guidance: Construction, online*, Scottish Environment Protection Agency, Edinburgh, Scotland
https://www.sepa.org.uk/regulations/water/construction/

4.2 HISTORIC ENVIRONMENT AND ARCHAEOLOGICAL REMAINS

4.2.1 Why this is important

Archaeological knowledge and their narratives can add both economic and social value to a project, which creates a distinctive sense of place for communities and "*helps foster a sense of belonging and contribute to well-being, inclusion and community cohesion*" (DLUHC, 2021).

The historic environment encompasses historic landscapes, sites, places, and other historic buildings. It also includes moveable treasures, collections, technological developments, and knowledge of the past that make up the unique character of the site and the cultural identities of people who lived there. Archaeological remains are part of the historic environment but are often invisible, hidden from view, or below ground.

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The surviving evidence of cultural heritage, spanning the whole period of human history, is an irreplaceable resource. It should be conserved appropriately according to significance so that it can be enjoyed by current and future generations. Developments should seek to minimise the impact on cultural heritage assets with the objective to preserve and conserve such assets. New knowledge can also be obtained from the investigation of archaeological and geo-archaeological sites.

If there are requirements or conditions relating to archaeology or the historic environment within the planning permission or client works information, it is because the site does, or has the potential to, contain a valuable and irreplaceable resource. Some monuments, sites, places, and buildings are protected by law, but the diversity of the resource means it can include, for example, natural landscapes and former landscapes (ie geo-archaeology, **Figure 4.12**) through to assets related to the modern era of industry and technology.

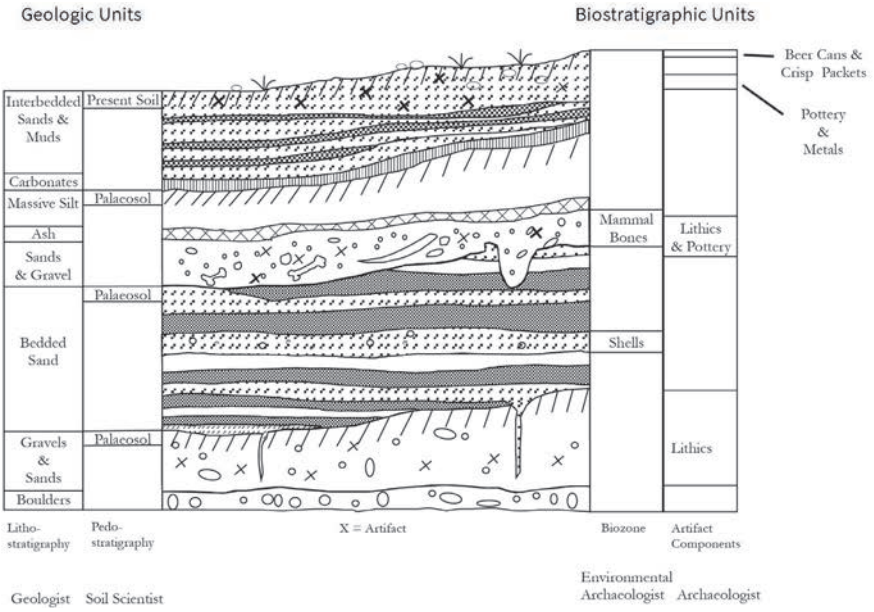


Figure 4.12 Variations in the interpretation of a geological sequence incorporating former landscapes from different professions (from Historic England 2015)

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4.2.2 Good practice checklists

Before construction	✓
Check if historic environment issues have been considered (usually found in a desk study report)	
Check if the relevant consents and licences related to the historic environment and archaeological matters have been identified and approved	
Check if pre-start historic surveys (including historic building and archaeology surveys) and investigation are needed and if so, make sure they have been completed	
Ensure an open communication approach with the public, which covers historic environment and archaeological assets, is adopted	
Check if required protection works have been identified for historic structures, eg baseline settlement monitoring	
Check if specialist suppliers, ie archaeological contractor, historic buildings specialist, have been procured	
Check if historic environment surveys and investigations have been fully integrated into the programme	
Check if the main contractor has made allowances for space, logistics and cost of supporting the archaeological works	
Check if historic environment issues are covered in EMP and/or MS construction drawings	
Check if procedures that manage unexpected discoveries have been agreed	
Check if the competent person has been appointed (see **Section 4.2.5**)	

During construction	✓
Make sure site staff briefings, eg site inductions and toolbox talks, cover historic environment and archaeological matters	
Make sure signage and demarcation of sensitive areas on site are in place to prevent site operations damaging historic environment and archaeological assets	

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During construction	✓
Make sure monitoring points for historic environment and archaeological matters are protected and monitoring (eg to determine settlement, groundwater levels) is undertaken if needed – this gives a warning that damage may be occurring to the archaeological resource	
Make sure construction programmes are up-to-date with information gained from historic environment surveys	
Make sure staff communication plans and weekly (or other periodic) meetings have been arranged and cover historic environment and archaeological matters if needed	
Make sure archaeologist's contact details have been added to daily briefings and permit system	
Make sure that the site audit includes checking historic environment and archaeological works are continuing in safe and tidy manner	
Make sure appropriate 'attendances' are in place (eg temporary works, plant, operatives, temporary roofing/cover [including guttering/water management to prevent bad weather delaying works], sufficient lighting for archaeological recording, welfare)	
Make sure potential for reuse of historic materials have been considered	
Make sure areas designated for on-site processing facilities are suitable to scale and type of investigation including water supply and silt trap for washing finds	

Off site	✓
Make sure instructions for reporting and post-excavation analysis on historic environment and archaeological assets have been issued	
Make sure a close out delivery programme has been agreed to ensure planning conditions and any consent/licence conditions are discharged/ closed out along with matters of finds ownership, and the dissemination and deposition of reports and the project archive	

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4.2.3 Statutory heritage organisations

In the UK, the protection and conservation of the historic environment is the responsibility of the statutory heritage organisation for the relevant region, ie:

- Historic England: **https://historicengland.org.uk**
- Cadw: **www.cadw.wales.gov.uk/historicenvironment**
- Historic Environment Scotland: **https://www.historicenvironment.scot**
- Northern Ireland Department for Communities: **https://www.communities-ni.gov.uk/landing-pages/historic-environment**

These organisations provide advice on legislation, policy, guidance, protection, and conservation issues specific to the historic environment and archaeology. They also support local authorities who make most of the decisions on how the historic environment is managed in their areas.

4.2.4 Legal and regulatory requirements

4.2.4.1 Designated assets

Permission or consent is required where construction works could impact upon designated heritage assets such as World Heritage Sites, Listed Buildings, Scheduled Monuments, Areas of Archaeological Importance, and conservation areas).

Consent for Listed Buildings is required for all parts of the building interior and exterior even if not mentioned in the official SHO list description and the reason for its designation.

The penalty for unauthorised works on designated heritage assets, which have been carried out without appropriate consent and granted by the appropriate regulator, can be costly. The preference, as far as possible, is to restore the asset to its original state, with an option for fines and criminal prosecution.

4.2.4.2 Ownership of finds

Ownership of archaeology varies between jurisdictions and transfer of title can be complicated.

Artefacts discovered on a construction site will belong to the landowner or to the Crown in Scotland, except for those that fall under legislation as 'treasure', which has a separate process (see **Section 4.2.4.3**). In most cases finds should be kept at

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the local museum who should have been contacted by the archaeological contractor or competent person at the start of the project. This process will vary depending on where the project is located in the UK and specific advice should be sought.

It is an offence not to report Treasure to the relevant authority and may be punishable by fines, imprisonment, or both. Remember that fines in England, Wales and Northern Ireland are unlimited!



4.2.4.3 Treasure

In England, Wales, and Northern Ireland, finds of precious metal (**Figure 4.13**), are reportable to the relevant registrar at the Coroner's Office within 14 days In Scotland all finds should be reported to the Treasure Trove Unit. There are different categories of find and specific advice according to the jurisdiction is published by the relevant government department.



Figure 4.13 Rare Iron Age coins (possible treasure) found at an HS2 site in West London (from HS2, 2021)

All finds of precious metal should be reported to the project manager (who is also the competent person) immediately and the archaeologist called to inspect the find to determine whether it is in association with other important objects.

If suspected precious metals are discovered work should cease immediately. The object(s) should be kept in a secure place and details of both the finder and landowner should be recorded in writing, as well as the time and place of the discovery, for submission to the local coroner. This will ensure that the interest of both the finder and landowner are considered when any reward may be determined.

Further information can be found at: https://www.gov.uk/treasure



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4.2.4.4 Wreck material

If wreck material is discovered, for example parts of a ship or its cargo, this should be reported to the Receiver of Wreck (which covers the UK) within 28 days. Fines will apply for failure to comply with the reporting requirements.

For more information go to: **https://www.gov.uk/government/groups/receiver-of-wreck**

4.2.4.5 Human remains

Legislation concerning the disturbance of buried human remains varies across the UK. A licence may be required before site works begin. The terms of the associated conditions and licences are complex, so specialist advice is essential if it is at all likely that burials will be encountered.

Conditions attached to an exhumation licence of human remains may require reburial by a certain date. Ensure that this is achieved or transfer this duty to a supplier before closing out the project. In Northern Ireland the archaeological excavation licence granted by NIEA have specific conditions attached that must be satisfied for closing out the licence.

4.2.5 Before site work begins

Ensure that a competent person is appointed to oversee and manage the historic environment and archaeological aspects of the project. Ideally, independent archaeological contractors or regulators should also be involved in the project. On smaller projects the environmental manager or general site manager may undertake the role and should consult with specialists and regulators when necessary.

Professional bodies membership for the competent person



Chartered Institute for Archaeologists: www.archaeologists.net

> Professional accreditation and standards for the historic environment sector in the UK.

Institute of Archaeologists of Ireland: www.iai.ie

> Professional accreditation and standards for the historic environment sector in Eire and Northern Ireland.

Institute of Historic Building Conservation: www.ihbc.org.uk/

> Principal professional body for building conservation practitioners and historic environment specialists.

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Unexpected discoveries can have a significant impact on the construction programme and are likely to increase the cost of the project. To avoid this, the following measures should be in place.

- Early planning and investigation to understand the resource and archaeological risks.
- Identify the potential for finds and, in particular, significant finds.
- Programming the construction works to follow archaeological mitigations. This may include additional investigation and excavation.
- Consider procedures for mitigating delays in the event of an unexpected discovery including early warning protocols.

Historic surveys and assessments should have been conducted at the planning stage to identify the historic environment and archaeological risks to be managed at the construction stage. Take professional heritage advice and use the good practice checklists in **Section 4.2.2**.

- Historic environment and archaeology requirements should be clearly set out in the EMP. These are based on information collected, reports, and documentation submitted to the local authority and/or SHO, which should be passed to the contractor, and include:
  - approved desk study – to inform the project design and planning application. It may be a separate report or incorporated in the Written Scheme of Investigation (WSI)
  - WSI – usually prepared by the specialist contractor/design archaeologist and should set out as a minimum, the scope, specification and outline programme for surveys and larger investigations together with procedures for dealing with unexpected or extensive discoveries
  - plans and drawings showing historic features and archaeological remains that need protecting
  - archaeological excavation MS – should include, as a minimum, the resources, temporary works, equipment and attendances required (ie facilities and services provided by the main contractor to support subcontracted elements of historic building/archaeological works), safe working methods, working hours, communication plan and any proposals for public engagement
  - legal consents – such as Scheduled Monument Consent, designated building consent, exhumation licence etc
  - notice – provided to relevant regulator (local authority or national heritage agency as appropriate) detailing the start of works

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- post-excavation MS – includes proposals for completion of off-site works and deposition of reports and finds with a local museum or other archive depositary, and wider dissemination of the discoveries made.

- Communicate any areas of concern and where archaeological remains require preservation in situ, methods of working and licence/consent conditions to staff.
- Where a watching brief (the overseeing of another contractor's work by an archaeologist) is required, ensure the relevant contractor is aware and has the contact details of the overseeing archaeologist in advance. Good practice would be to include this information on the permit to dig system.
- Develop a procedure to deal with unexpected discoveries and ensure all site workers understand when they may need to stop work due to encountering unexpected archaeological conditions.
- Develop site plans to show areas where recording and monitoring of the in-situ archaeology to remain is required and identify those archaeological remains for removal which must be recorded.

Before works start on site all staff should attend a site induction where they are informed of any historic or archaeological constraints and requirements, for example licences, recording and monitoring. Site staff should be made aware of the special working methods they would need to adopt such as methods of piling, areas where heavy traffic movements could result in compression of remains, or monitoring for settlement, vibration, and groundwater levels.

Toolbox talks are a useful tool for informing and/or educating the site team. CIRIA's environmental toolbox talks are free to download from:
https://www.ciria.org/CIRIA/Resources/Toolbox_talks.aspx

What to do with buildings of special architectural or historic interest

Some buildings and other structures and areas are 'designated' and are protected by law in the UK. Measures to protect and/or record these should be identified at the planning stage of the project and included in the EMP and/or MS. Other buildings or structures may be on a local authority register of important historic buildings because they add positively to the character of a place and are a material consideration at the planning stage.

To ensure that there is no loss of important historic fabric without record, and before demolition, the following should be carried out on known historic structures, or if historic structures are discovered during ground clearance:

- Consultations with LPA to determine what permissions and consents are

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required, for example unlisted buildings in a conservation area usually require planning permission.

- Obtain the opinion of the professional buildings archaeologists to determine the historical and archaeological significance of the asset.
- Complete a photographic and built structural record if the assets are of historic interest. This could be done quickly and inexpensively. The record should be submitted to the relevant local archives.

If in doubt, contact the local authority conservation office.

Sustainable reuse of historic materials

Consider the option to reuse historic features, fabric, and materials either within the project or via a third-party organisation (subject to agreement with and the archaeological contractor (the competent person).

4.2.6 During construction

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Follow mitigation as set out in the WSI and implement methods of working in a legally compliant manner (including meeting consents or permissions conditions); action taken will often comprise full excavation, recording/restoration of historic structures or preservation in situ of the remains, or a combination.

Note that the contractor's permission to demolish structures should not be issued until required historic building survey reports are received and authorised by the project manager or client.

Care needs to be taken during the construction stage to prevent direct (eg topsoil stripping) or indirect effects (eg contamination of archaeological deposits from grout curtains) on archaeological remains. For further information see CIRIA C799 (Nixon *et al*, 2021).

Often archaeological works are done in advance of the main construction works. Use completion certificates to document handover of completed areas. This could include information that allows the impact of archaeology on the programme to be quantified, for example, scope and dates for completion of different activities, site communication and staff training.

Where archaeological remains may be retained and preserved in situ care should be taken to ensure that established methods are followed and, where necessary, specialist advice is obtained.

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4.2.6.1 Managing unexpected discoveries

During construction, major discoveries, ie unanticipated at the planning stage of a project, do occur (see **Figure 4.14**). The most important action will be early and comprehensive communication with the client, the regulator and the project management and teams. Where finds might be legally considered treasure or wreck material they must be reported (see **Sections 4.2.4.3 and 4.2.4.4**).

If remains (**Figure 4.15**) are found unexpectedly:

- cease work and cover the excavation from public view
- contact an archaeologist immediately to determine if they are human or animal. If they are human remains, a licence will be required from the Ministry of Justice, which can usually be obtained within 24 hours from reporting the find
- conditions may allow for the work to continue, but only under the supervision of the archaeologist. In Northern Ireland, the Police and the Coroner's Office must be contacted when human remains are uncovered. In Scotland, it is the developers' responsibility to inform the police immediately on the discovery of any human remains.



Figure 4.14 Archaeological excavation (courtesy Oxford Archaeology)



Figure 4.15 Archaeological excavation of human remains (courtesy Skanska)

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Plan ahead – carry out appropriate surveys to reduce the risk of unexpected discoveries.



4.2.6.2 Monitoring

Dependent on the regulatory framework, site works for the historic environment may require monitoring by external officers based with a local or national authority. Advice or instruction received from external organisations should be formerly documented. Changes to the accepted scope and programme of works should not be made without the project manager's approval.

4.2.7 Managing public interest and the media

Adopt an open communication approach with the public. When 'done well' this can often lead to positive public relations and help deliver corporate sustainability and corporate social responsibility objectives.

Opportunities to engage with the public and media, and to display finds (both temporarily and built into permanent works) should be encouraged because they belong to the community and improve local PR.

4.2.8 Off-site works and close out

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While not part of the site management stage, it should be noted that there is often considerable post-fieldwork off-site historic and archaeological phase of assessment and reporting. When determining costs for undertaking historic and archaeological mitigation works, this should include post-fieldwork obligations such as:

- laboratory analysis and studies of the environmental and artefact assemblages
- preparation of reports and formal publications
- deposition of archives.

These off-site works are often a requirement of various permissions. For example, consents often include conditions to ensure that the deposition of documents, publications and archives relating to designated sites is successfully carried out.

Planning conditions may not be fully discharged until all off-site works are completed. This can typically take 24 months following completion of site works.



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Further reading

HISTORIC ENGLAND (2015) *Geoarchaeology. Using Earth Sciences to understand archaeological record*, Historic England, London, UK
https://historicengland.org.uk/images-books/publications/geoarchaeology-earth-sciences-to-understand-archaeological-record/heag067-geoarchaeology/

GOV.UK *Report wreck material*: **https://www.gov.uk/report-wreck-material**

HS2 Ltd (2022) *Archaeology*, HS2 Ltd, UK
https://www.hs2.org.uk/building-hs2/archaeology/

MOJ (2013) *Apply to excavate human remains for archaeological purposes (England and Wales)*, Ministry of Justice, London, UK
https://www.gov.uk/government/publications/apply-to-excavate-human-remains-for-archaeological-purposes

RAPP, G J and HILL, C H (1998) *Geoarchaeology: the Earth science approach to archaeological interpretation*, Yale University Press, New Haven, USA

4.3 LAND CONTAMINATION

4.3.1 Why this is important

Land contamination can be caused by historical industrial activities on a site, construction and demolition waste remaining on site, criminal activity such as fly-tipping, or the presence of naturally occurring substances.

Contamination can lead to:

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- delays to construction programmes through unexpected or accidental contamination (eg spills and leaks)
- liability to the developer and contractors on site, for costs associated with making contamination worse
- blight and subsequent reduction in site value
- ill health of site staff and the local community (through contact with the contaminants such as asbestos fibres, dust, gases, affected soils, groundwater etc)
- damage to ecological systems, buildings, and structures
- pollution of ground and surface waters
- public concern and anxiety

Land contamination may be present as:

- solid (eg UXO)

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- liquid (eg leachates – liquids containing dissolved contaminants, which can pollute ground and surface water)
- gas (eg carbon dioxide. Some contaminants in vapour phase can pose both an explosion risk and other long-term health risk).

4.3.2 Good practice checklists

Before construction	✓
Check if the relevant environmental permits are in place	
Check if there are any land contamination planning conditions and other requirements, eg warranty providers for mitigation and, if so, what are they	
Make sure the locations where the contamination or potential contamination have been identified	
Make sure the site staff have received the appropriate training– particularly to deal with certain contaminants such as asbestos	
Make sure the appropriate PPE are provided and site workers have been trained in its use	
Make sure staff understand any monitoring and verification plan related to land contamination	
Make sure all site investigation and risk assessment reports are available. Where remediation is required check that it has either been implemented as set out in the verification report or, if it is still to be implemented, a copy of the remediation strategy has been obtained where appropriate	
Make sure an incident/emergency plan related to land contamination is in place	

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During construction	✓
Data collection	
Check if there is a need to collection data for verification plan, duty of care etc	
Avoid causing or spreading contamination	
Avoid stockpiling contaminated soil. If it is possible, stockpile only on a hard-standing area to prevent contamination of underlying ground	
Cover stockpiled material to prevent wind-blown potentially contaminated or contaminated dust from spreading and to prevent ingress of rainwater	
Control surface water drainage from the stockpiled area. Water draining from a stockpile may be contaminated and require controlled off-site disposal	
Take care when handling, storing, and using oils and chemicals	
Identify a quarantine area for potentially hazardous materials	
Be vigilant and look for signs of contamination	
Discoloured soil (eg chemical residues)	
Unexpected odours (eg hydrocarbons such as petrol)	
Fibrous texture to the soil (eg asbestos)	
Presence of foreign objects (eg chemical/oil containers/waste)	
Evidence of previous soil workings	
Evidence of underground or storage infrastructure such as fuel tanks and dispensers	
Ground where the level has been raised by past activities and not due to natural causes (eg construction platforms for old industrial buildings made of imported wastes such as ash)	
Old drain runs and contamination within buildings such as tanks, flues etc	
Seepage of leachates and liquors from fissures etc indicating a hidden source	
Presence of contaminated soakaways and unlined voids (such as tar wells on old gas-producing sites)	
Where the suspected contaminated materials should be managed	
If unexpected contaminants are found on site, stop work, and contact the competent person who is usually a geo-environmental specialist for further investigation	

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4.3.3 Legal and regulatory requirements

Land contamination is regulated via planning and Part 2A of the Environmental Protection Act 1990 in England and Wales, Part IIA and Planning Advice Note 33 (Scottish Government, 2017) in Scotland, and Part III of the Waste and Contaminated Land (Northern Ireland) Order 1997. A site is 'contaminated' if the contaminants pose significant risk to receptors, such as humans and the environment, and mitigation is required to remove or at least reduce the risk to an acceptable level. The Environmental Damage (Prevention and Remediation) Regulations 2009 place obligations on construction companies to prevent land contamination.

Where a site is contaminated, the ultimate responsibility for safe development is with the client/developer. The planning authority may refuse a planning application, assign contaminated land related conditions to a planning permission, or accept/reject what the developer proposed. The planning authority may assign contaminated land related conditions to a planning permission.

4.3.4 Causes of land contamination

Contamination may arise from historic polluting land uses or from naturally occurring contaminants. Contaminants can spread or migrate onto or off the site via:

- windblown dust
- surface water runoff
- trafficking of mud
- permeable strata or artificial pathways (eg utility corridors, abandoned monitoring wells)
- groundwater etc.

A site is only contaminated if there is a source–pathway–receptor linkage. Poor management of materials on a site, for example diesel used to run generators, leaks of hydraulic fluids from heavy equipment, and poor management of site hygiene facilities, can also lead to contamination of site soils and groundwaters.

Construction activities can create new pathways and increase the impact of contamination. For example, excavation of soil may bring contamination to the surface and piles may connect affected groundwater at shallow depth with a primary aquifer.

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4.3.5 Types of contaminants

A wide range of contaminants can be found on UK sites, including heavy metals, oils and tars, chemical substances, solvents and gases. Some contaminants have their own health and safety legislation, such as asbestos. Other land contaminants are chemicals that have been used in the UK for many years such as asbestos, polychlorinated biphenyls (PCBs), and dichlorodiphenyltrichloroethane (DDT) – which are considered as persistent organic pollutants (POPs).

The following sections discuss commonly found and unique contaminants.

4.3.5.1 Unexploded ordnance

Despite the low frequency of encounters and safety records in the UK, UXO is a special land contaminant because it can cause immediate casualties and fatalities.

UXO can be reactivated by:

- direct impact (eg with an excavator bucket)
- vibration
- heating (eg friction from pile or borehole drilling).

The site risk assessment should reveal the potential UXO risk of the site. Areas with a considerable UXO risk include former military land, historically bomb. More can be found in CIRIA C681 (Stone *et al*, 2009).

Assume all suspected UXO is unstable – do not handle or disturb



4.3.5.2 Asbestos

Exposure to asbestos is the single greatest cause of work-related deaths in the UK. Asbestos-containing materials (ACMs) are often found in buildings constructed before 2000 and most brownfield sites. The HSE has dedicated regulation and guidance on asbestos (from buildings and soil) on:
https://www.hse.gov.uk/asbestos/managing/brownfield.htm

ACM fragments in rubble or soil can be easily overlooked and fibres in rubble or soil are generally not visible to the naked eye.



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A risk assessment (involving desk studies and ground investigation) should be carried out on site to determine if asbestos is present in soil. This will reduce the possibility of an unexpected discovery of ACMs before work starts.

The site remediation strategy, asbestos management plan, and/or the material management plan should be confirmed and documented and included as part of the MS before starting work. Once developed, these should be clearly and regularly communicated to all site workers.

Before any works starts, if initial investigations identify asbestos as being on the site, it must be established whether the work is licensed or non-licensed.

Licensed work is high risk and must only be carried out by licensed contractor. This includes work that:

- removes sprayed coatings (limpet asbestos), and which may disturb pipe lagging
- involves loose fill insulation and asbestos millboard
- cleans up significant quantities of loose/fine debris containing ACM dust etc (where the work is not sporadic and of low intensity, the control limit will be exceeded, or it is not short duration work).

If the work is **non-licensed**, the competent person must confirm whether the work is notifiable or not.

CIRIA C765 (Studds and Bell, 2017) provides more guidance.

Asbestos awareness training must be provided for those whose work could possibly disturb asbestos and those who supervise or influence the work.This also includes work involving soil which may have been contaminated with asbestos.

Where works will knowingly disturb ACMs, for example sampling or hand-picking of ACM (ie non-licensable work or notifiable non licenced work), staff must receive additional task-specific IIT. Annual refresher training is needed for licensed and non-licensed work.

CIRIA C765 (Studds and Bell, 2017) provides further information.

4.3.5.3 Hazardous ground gas

Hazardous ground gases are often found on construction sites. They can cause acute effects such as explosions and asphyxiation, as well as long-term illness.

Types of ground gas include:

- **Permanent gases.** Methane and carbon dioxide are often found in landfills and areas of prevailing geology, or where there have been mine workings. Methane can cause an explosive atmosphere in buildings and carbon dioxide can result in harm to building occupants (including shortness of breath, headaches, loss of consciousness and death).

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- **Vapour phase** contamination is a group of compounds that are volatile. The main source is the historic use of a site/local area, for example leaks from bulk storage tanks, and chemical/fuel spills. Some vapour phase compounds are known carcinogens at extremely low concentrations.

It is important that site staff are aware of ground gas risks. Works should be carried out in accordance with the prepared risk assessments and MSs, with appropriate monitoring and PPE used at all times. Confined space entry requirements may apply for below ground excavations where man entry is necessary.

Site managers should seek specialist advice in the design, implementation, and verification of ground gas mitigation measures. However they should ensure remediation measures, particularly gas membrane, are not damaged by other site activities. For more information see CIRIA C801 (Mortimer *et al*, 2021).



4.3.5.4 Lead

Lead is a special contaminant. HSE (2002) states that it is a legal requirement to carry out air monitoring if the risk assessment indicates that any employees (ie site workers) may be significantly exposed to lead.

Lead is found on many construction sites, particularly those carrying out demolition and dismantling activities, such as stripping of old lead paint from doors, windows, and other parts of builders, and hot cutting. Some lead also ends up in soil from these activities. Lead concentrations in shallow soils can also arise from natural sources where geological mineralisation is high, and from atmospheric deposition. Inhalation and ingestion are the primary routes of exposure.

More can be found online from the HSE (n.d.2), and in PHE (2017).

4.3.6 BEFORE SITE WORK BEGINS

Risk of land contamination should be managed by gaining a full understanding of the site before works begin. According to EA (2021e) this should include a detailed site investigation to determine the presence of contamination in and under the land, to assess the source-pathway-receptor linkages, and to decide if remediation is necessary. **Table 4.1** summarises the documents and information a site manager should be aware of, and should have access to, before working on sites that have land contamination.

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Table 4.1 Land contamination related documents and information

Documents or information needed	Details
Risk assessment report	All sites where contamination is suspected should be assessed through the land contamination risk management (LCRM) Stage 1 risk assessment before construction work begins.
Remediation strategy	If measures to manage contamination are necessary, a remediation strategy should be developed, implemented, and verified. The remediation framework for land affected by contamination is outlined in *LCRM: Stage 3* (EA, 2021c).
Agreement from the local authority	The proposed remediation approach needs to be agreed by the local authority and other parties before any work begins.
Verification report	The documentary evidence that the relevant contaminant linkages have been dealt with in accordance with the agreed remediation strategy, and requirements for any ongoing monitoring and maintenance.
Permits/licences/ consents	These can be, for example: • mobile plant permits/licences for mobile crusher/ screeners and/or treatment plant used on site • environmental permits for storage and use of waste in deposit for recovery activities involving construction, reclamation, restoration, or improvement of land other than by mobile plant • relevant licences in Scotland, for any water-related activities, eg dewatering discharges • environmental discharge permits for dewatering activity in England, Northern Ireland and Wales.

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The site manager should also be aware of:

- planning conditions that are related to land contamination. Discovery of contamination may occur during site work. In this case, further site investigation will be required
- remediation processes that will take place and their relationship with other site activities. For example, when a gas membrane is laid, it is important to know how they will not be damaged by trade work.

Depending upon the developer's requirements, some remediation may have been undertaken before development works have begun. However, on many large brownfield sites, the remediation program and the build program are zoned and phased to allow development works to be completed concurrently. On these sites, the site manager may have responsibility of managing the remediation subcontractor as well as the development team and has the added responsibility of managing the overall development program.

The site manager needs to be aware that the design of the development could modify the receptor or the pathway if the site is contaminated. It is important to ensure that the construction activities will not mobilise the contaminants, for example excavation of soil can bring contamination to the surface and installation of drains could create a pathway.

The site manager should appoint a competent consultant to provide advice to manage land contamination.

Contaminants and waste soil classification - A waste producer is required to describe the waste and assign a LoW code in accordance with Technical Guidance 3 (WM3) (EA, NRW, SEPA, 2021 and NIEA, 2022). In addition, if surplus soil (whether contaminated or not) is disposed to landfill a waste acceptance criteria (WAC) test will be needed to determine which type of landfill will accept the waste and whether the waste requires further treatment before disposal (unless defined on the list, a limited number of wastes that may be assumed to fulfil the criteria of inert waste as set out in Article 2(e) of Council Directive 1999/31/EC (Landfill Directive).

A WAC test does not allow the determination of whether a waste is hazardous or not (see Section 4.5.3).

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Training (face-to-face, virtual, or toolbox talks etc) should be provided for site staff before working on site. This is to ensure safety and to understand the risk posed by the contaminants present on site, and what they need to do to mitigate risks to themselves, the general public, and the environment.

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4.3.7 During construction

4.3.7.1 Monitoring

In many contaminated land projects, monitoring and verification are required to demonstrate the remediation works have been carried out as agreed and achieve their objectives/targets. This is usually done by the contaminated land consultant and contractors. However, site workers need to be aware of this so that they do not inadvertently damage monitoring points and block ground gas ventilation areas; they should know what to do to protect the integrity of an installed gas membrane.

4.3.7.2 Unexpected discovery

If a robust site investigation and risk assessment has been carried out before the start of a construction project, the likelihood of discovering unexpected contamination during site works is lower.

However, always look out for unusual colouring or ground structure. The release of noxious fumes, petrol, oil, solvent, and odour etc may indicate the possibility of land contamination.

For most contaminants, if they are encountered unexpectedly:

- stop work immediately
- report the discovery to the site manager, so they can seek expert advice. The site manager should contact the contaminated land specialist (usually a geo-environmental consultant). Also, contact the relevant regulators – in most cases this is the local authority contaminated land officer/environmental health officers (EHOs) and/or EA, SEPA, NIEA depending on where the site is located
- isolate the area and contain any spread of contaminants
- clear and isolate the affected area, contain any contaminants and do not leave anything that could cause ignition.
- ensure that the suspected contamination is tested and analysed; agree on changes to any existing remedial plan or produce a revised remedial plan if appropriate.

Due to the nature of UXO, specific emergency procedures are needed. For more information please go to CIRIA C785 (Bowman *et al*, 2019).

Also where an unexpected UXO encounter occurs, this is an 'incident' and one that will be escalated through regional police forces to the MoD, or the Metropolitan Police in London.



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Further reading

HSE *Asbestos information, instruction and training*: **https://www.hse.gov.uk/asbestos/training.htm**

4.4 NUISANCE

The world's climate is changing. More extreme high summer temperatures over prolonged periods dry out soils, which means nuisance caused by poor site practice such as dust, volatile emissions, odour, and vibration will become more serious. Intense rainfall may also result in failure of surface water management on site leading to water and mud escaping the site.



4.4.1 Dust, emissions and odours

4.4.1.1 Why these are important

Dust is airborne particulate matter up to 75 µm in diameter. It can cause:

- nuisance, such as volatile emissions from plant and generators, which can affect neighbouring properties and vehicles through air pollution and odours
- annoyance to residents, who may have to re-clean washing hung outside or clean cars, curtains windows etc. Wind-blown dust can be unsightly over long distances in scenic areas
- health issues such as eye, nose, and throat irritation. Exposure to respirable dust can exacerbate pre-existing medical conditions, eg chronic obstructive pulmonary disease (COPD) and asthma. Some dusts may contain silica and asbestos fibres or other contaminants, which can lead to long-term health conditions to site workers and people living and working near the site
- adverse ecological impacts to both aquatic and non-aquatic plants and animals. Poor air quality is also a contributor to the long-term decline in biodiversity

Odours emitted from site can cause irritation to people passing by or living near to a site.

Over 500 construction workers are believed to die from exposure to silica dust every year (HSE, 2020a): **https://workright.campaign.gov.uk/campaigns/construction-dust/**

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4.4.1.2 Good practice checklists

Good housekeeping	✓
Haul routes	
Beware of the non-road mobile machinery (NRMM) low emission zone in London where councils have planning powers to control emissions from NRMM used on construction sites	
If possible: • select suitable haul routes away from sensitive receptors • reduce the length and width of haul roads to minimise the surface area where dust is produced • temporarily surface heavily used areas, or use geotextiles (eg around batching plant or haul routes)	
Carry out regular mechanical road sweeping, manual sweeping, scraping and jet washing to remove excess build-up of materials on site and on public roads. However care should be taken to ensure contaminate water will not be washed down to surface water drains and water courses	
In dry weather, dampen down soil with water, which may include chemical surfactants	
Demolition	
Use enclosed conveyors and chutes for dropping demolition materials that have the potential to cause dust. Regularly dampen the chutes	
Make sure consent from the regulator for the use of mobile plant for crushing materials such as bricks, tiles, and concrete have been obtained	
Use debris netting during demolition to reduce dust emissions	
Use water atomisers to reduce dust emissions	
Locate crushing plant away from sensitive receptors	
Plant and vehicles	
Make sure vehicles and plant used on site are well maintained and regularly serviced with up-to-date maintenance records	
Make sure all vehicles used by contractors comply with MOT emissions standards	
If any plant or vehicles emit black smoke, they should be taken out of service immediately and defects rectified	

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Good housekeeping	✓
Clean the wheels and surfaces of vehicles leaving the site so that mud is not spread onto the highways	
Use retractable sheet to cover vehicles to enclose dust	
Vehicles should keep to site speed limits to reduce the risk of dust clouds	
As far as possible locate plant away from sensitive receptors	
Control deliveries to site to minimise queuing	
Make sure that engines (including vehicle engines) are switched off when they are not in use	
Carry out refuelling in designated areas away from the public	
Materials handling and storage	
Locate stockpiles away from wind (or provide wind breaks) to minimise potential for dust generation	
If possible, stockpile materials within walled bays to minimise spreading dust	
Store materials away from the site boundary, main site access roads, and downwind of sensitive receptors	
Minimise the drop height of materials and, where possible, enclose (eg using enclosed chutes)	
Damp down earthworks during dry weather	
Roll and re-vegetate long-term stockpiles, cover (eg using hessian or jute matting), and consider use of chemical dust suppressant additives for short-term control	
Make sure tipping of loads is carried out in a controlled manner	
Make sure waste skips are enclosed or covered	
Concrete batching	
As far as possible store dry materials (eg cement) indoors	
Cement should be stored in silos with appropriate dust abatement equipment	
Cutting/grinding/grouting/packing	

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Good housekeeping	✓
Minimise cutting and grinding on site where possible	
On cutters and saws, use equipment and techniques such as dust extractors to minimise dust. Consider a wet cutting saw, or use vacuum extraction or block splitters	
Spray water during cutting of paving slabs to minimise dust	

Preventing emissions and odours	✓
Waste storage	
Use covered containers for organic waste (eg food, weeds, and other vegetation) and remove waste frequently to reduce odours	
Make sure septic tanks are emptied regularly	
Chemicals on site	
Take account of the prevailing wind conditions when arranging activities that are likely to emit aerosols, fumes, odours, and smoke	
Position site toilets away from residential areas	

4.4.1.3 Legal and regulatory requirements

Under Section 80 of the Control of Pollution Act 1974 a local authority may, by notice, require owners of construction sites to estimate or provide other information on emission. Local authorities in England, Scotland, and Wales are required to inspect their areas and investigate any complaints made relating to dust, emissions, and odour nuisance.

In Northern Ireland this is undertaken by the Department of Agriculture, Environment and Rural Affairs and district councils. Statutory nuisances or breaches of permit requirements (eg mobile crusher activities carried out under a mobile part B permit) can result in abatement notices or enforcement action (in terms of breach of permit) being served if complaints have been received.

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The Control of Substances Hazardous to Health Regulations 2002 (COSHH) requires employers to control substances that are hazardous to health. The HSE provides guidance on good control practice, and states the need to minimise emission, release and spread of substances such as dust, which are hazardous to human health.

In London, a new 'low emission zone' for NRMM has been created to control emissions on construction sites. This will restrict the use of some excavators, pumps and generators and other heavy-duty equipment (see GLA, 2022).

4.4.1.4 Type of dust

Dust from construction sites includes:

- **Silica** – from activities that involve silica containing materials such as concrete, mortar, and sandstone (also known as respirable crystalline silica, RCS).
- **Wood** – from activities that involve softwood, hardwood, and wood-based products such as medium density fibreboard (MDF) and plywood.
- **'General'** – the most common include gypsum (eg in plasterboard), limestone, marble, and dolomite.

Not all dust is equally hazardous

Some dusts have specific workplace exposure limits (WELs) which provide a guide for employers to help them control exposure. For example, silica dust, which is a found in rocks, sand, clay, bricks, concrete etc, has a WEL of 0.1 mg/m. This means that during an eight-hour period, a worker should not inhale more than this.

There is a growing consensus that even if the exposure level is below WEL, there is a risk to the health of employee and other people affected by site activities. It is important to ensure that any exposure to dust is kept as low as possible.

For more information: **https://www.hse.gov.uk/dust/faqs.htm#types**

4.4.1.5 Sources of dust, emissions, and odours

Common sources of dust, emissions, and odours from construction projects include:

- dry, unpaved haul roads
- mud on public roads
- tipping (from height)
- uncovered vehicle movements
- uncontained/uncovered equipment (eg crushers, conveyors)

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- material stockpiles
- cutting, grinding, and drilling operations
- shot-blasting
- earthworks
- waste organic material, sewage or from chemicals
- escaped emissions from diesel powered generator or from materials such as paints and mastics etc.

4.4.1.6 Dust mitigation

Damp down



Figure 4.16 Dust suppression (courtesy Galliford Try plc)

- Spray regularly, especially during warm and sunny weather when water will evaporate quickly.
- Damping down, using water in dry weather, only offers a temporary solution (**Figure 4.16**). More recently, dust suppressants/ binders, such as calcium chloride, has been used to dampen road surfaces, even in hot weather, to reduce dust. Calcium chloride is hydroscopic, ie it can attract moisture from air and resist evaporation. However care should be taken to avoid contamination of the ground water. For a longer lasting outcome it may be appropriate to mix additives and chemical binders to the water. Spraying with water and chemical additives is more effective than using water alone because this will reduce the number of passes per day and the volume of water needed. It is important to review the safety data sheet to ensure the spraying mixture is managed appropriately on site.
- Ensure that the application does not create excessive mud or a flow of dirty water that can runoff into watercourses. This can lead to prosecution by the environmental regulator.
- Consider spraying:
  - unpaved work areas subject to traffic or wind
  - site haul roads
  - structures and buildings during demolition
  - sand, spoil, and aggregate stockpiles
  - during the loading and unloading of dust generating materials.

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Dust screening

If dust-generating activities cannot be avoided, it may help to erect screens to act as windbreaks or dust screens These can be permeable or semi-permeable fences, trees or shrubs planted early as part of site landscaping, which can provide some screening as can the retention of existing vegetation (or buildings to be demolished). Also, in building demolition, retention of external walls while internal demolition and deconstruction is being undertaken will offer dust screening.

If possible, non-potable water should be used for damping down, eg rainwater captured on site or using water abstracted from a nearby watercourse.

If abstracting water for spraying from a watercourse or fire hydrant, a licence is likely to be required – make sure to obtain the appropriate consent.

During extended periods of drought, water use may be limited, and stockpiles may need to be covered with sheeting. Preventive measures, such as dust screens and tracking mats, should be put into place to reduce tracking of dust and soil around on or off site.

Consider where discharges will go because of damping down (ie to storm drains or watercourses).

Dust suppression

Sweeping (road and manual) and scraping can remove dust build up on site.

Physical enclosure

This includes:

- using haul vehicle covers
- enclosing/covering equipment (eg crushers, conveyors)
- enclosing areas where shot-blasting is undertaken
- using sheeting/debris netting around scaffolding.



Figure 4.17 Noise and dust mitigation (courtesy Brookfield Multiplex and Keltbray)

Good site management and traffic arrangement

Spread of dust can be reduced by:

- rolling and seeding stockpiles or cover (eg with jute matting), apply chemical binders to stockpiles or exposed ground, and locate enclosed stockpiles and batching plant in sheltered areas

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- using appropriate surfaces (ie tarmac)
- applying speed limits on haul routes (see **Section 4.6**)
- using rumble strips at site egresses.

4.4.1.7 Before site work begins

For all methods used, dust samples need to be obtained before work starts to determine background levels for comparison against those taken during construction.



Dust

- Develop a strategy to stop dust being generated. Careful planning and design of construction operations can reduce dust.
- Identify sensitive receptors and any activities likely to cause dust, odours, or emissions affecting residential/surrounding land uses, schools, wildlife, statutory designations, and watercourses.
- Liaise with the local authority to develop a dust management plan and adopt control measures to mitigate any negative effects (eg site speed limits, use of water bowsers, sheeting of vehicles and skips).

Emissions and odours

- Any works that risk creating odours should be planned appropriately.
- Any processes that emit fumes, odours, or smoke should comply with the manufacturer's and, if appropriate, regulatory limits to prevent nuisance or a regulatory breach.
- All plant and vehicles should be regularly maintained. A programme of maintenance checks for plant on site should be developed and adhered to.
- Smoke from plant and fires could be deemed a statutory nuisance and/or the creation of dark smoke from an industrial or trade premise could be deemed an offence under the Clean Air Act 1993. The local authority can enforce (informally or formally) a stop to those activities generating the smoke.
- Consider fitting exhaust filtration systems to vehicles. Ensure any plant and equipment emitting black smoke is taken out of service immediately and the defect rectified. As far as possible locate plant away from sensitive receptors, ie neighbours and local ecology. Where possible, use 'green' mains or battery powered equipment (see **Section 4.5.1**).

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- Ensure staff have the appropriate training:
  - about dust risks and how this can harm their health
  - how to use the dust controls and check that they are working
  - how to maintain and clean equipment
  - how to use and look after respiratory protective equipment (RPE) and other PPE
  - what to do if something goes wrong.

If plant or machinery emits excessive (ie amounting to nuisance) levels of exhaust emissions, local authorities have the power to prescribe limits on those emissions – any breach may be an offence. Old plant, or plant carrying out an operation that it is not designed for can fall foul of the prescribed limit. They also tend to be less energy efficient. Plants that are fuelled by renewable energy sources are becoming more available, for example using hydrogen-powered excavators.



4.4.1.8 During construction

Visual observations

The site manager, or other nominated site person, should remain vigilant for observable releases of dust so that action can be taken. All observable dust release should be recorded including visible evidence of dust soiling.

Monitoring

Monitoring is important, particularly for sites where there are agreed air quality action levels with the local authority.

A monitoring regime should be linked to the management plan to trigger preventative measures and actions when monitoring results indicate elevated dust levels.

Regular monitoring and keeping a record of dust management activities, which need to include details of the weather conditions at the time of the assessment (eg wind speed, direction), should be undertaken. Routine reviews and checks should include:

- ensuring that controls are effective
- maintenance of equipment:
  - regularly look for signs of damage and ensure repairs are undertaken efficiently

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- replace disposable masks in line with manufacturer's recommendations
- properly clean, store, and maintain non disposable RPE. Change RPE filters as recommended by the supplier
- carry out a thorough examination and test any on-site dust extraction systems at least every 14 months.

A range of dust monitoring techniques are available in the UK. These include real time monitoring, Frisbee gauges, and microscope slides. Other methods and guidance on location of monitoring points are given in IAQM (2018).

Where a health surveillance programme is needed, advice from an occupational health professional should be sought.

4.4.2 Light

4.4.2.1 Why this is important

Too little light vs too much light

- **Too little light –** working under poor lighting can result in eyestrains, headaches, and awkward posture, which can create a stressful and unhealthy working environment for employees. Over time the well-being of construction employees can be compromised. Inadequate lighting might also adversely affect employee morale, which can consequently impact productivity.
- **Too much light and poor light management** can:
  - cause discomfort to those working nearby
  - lead to nuisance and annoyance to residents. There are also potential health risks, for site workers, motorists and members of the public as lighting glare can dazzle or cause impaired vision. This can reduce awareness of any nearby hazards and cause accidents
  - interfere with local ecology, such as birds and nocturnal species, in particular bats, amphibians, and insects. The disturbance can affect migration and feeding and breeding patterns
  - lead to unnecessary energy cost. This is becoming more significant in many projects with recent rising fuel prices.

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4.4.2.2 Good practice checklists

Controlling light pollution	✓
Identify sensitive receptors for light pollution	
Position/direct light away from sensitive receptors	
Use directional lighting	
Avoid over illumination where lighting intensity is higher than which is appropriate for the activity conducted	
Light areas only when required	
Install lighting accessories to reduce/mitigate light spillage, eg hoods, shields, reflectors	
Implement 'switch off' schemes	
Install motion sensors and timers	
Use appropriate power levels of illumination	
Install features to reduce lighting, eg 'last man out' switch, infrared security lighting	

Reduce lighting energy consumption	✓
Avoid excessive use of lighting, use fewer lamps and of lower wattage	
Implement 'switch off' schemes	
Install energy efficient lighting, eg LED and halogen bulbs	
Use appropriate power of illumination	
Install sensors and timers	

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4.4.2.3 Legal and regulatory requirements

Good lighting is vital to the health and safety of site workers. The regulatory control is embedded in health and safety legislation, for example, The Management of Health and Safety at Work Regulations 1999, The Workplace (Health, Safety and Welfare) Regulations 1992, The Construction (Design and Management) Regulations 2015 and The Fire Safety (England) Regulations 2022.

Local authorities are obliged to investigate complaints of light pollution if it is believed that the light could be considered a 'statutory nuisance'.

4.4.2.4 Lighting management

Controlling light pollution

Careful selection and planning lighting (including security light) can reduce the effects of light pollution.

Reducing energy consumption

HSE (1997) states that on construction sites there should be, as far as possible, natural light for people to carry out their activities and move about the site safely. However, where natural light is inadequate or not available, artificial lighting should be provided.

Recently, being more energy efficient has become important on construction sites. This is due to both rising energy prices and pressure on the construction industry to reduce its carbon emission. Use of energy-efficient lights such as LED and renewable energy sources such as photovoltaic (PV) are becoming very popular.

Benefits of LED lighting

LED lights are known for their energy efficiency. They consume about 75 to 90 per cent less energy compared to incandescent lights. They are also resistant to shock, vibrations, and external impacts. LED lights can withstand heavy exposure to weather, external vandalism, and traffic-related conditions, which makes them perfect for areas with tough conditions, such as outdoor construction sites.



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4.4.2.5 Before site work begins

Planning

Prepare a lighting plan, which should include the types of activity that will require lighting. These activities can be given an illumination target (with the unit being lux). HSE (1997) states that the average illuminance for construction work should be minimum of 20 lux and an average of 50 lux. The plan should also:

- identify sensitive receptors surrounding the site
- determine how to position/direct lighting away from sensitive receptors
- consider using directional lighting
- determine the appropriate levels and areas of illumination
- determine the minimum amount of lighting, without compromising health and safety
- consider installing hoods, louvers, shields, reflectors, and baffles to mitigate or reduce light spillage
- consider installing motion sensors, timers, or a 'last man out' switch (ie the last person can switch off all non-necessary lights in one single switch)
- consider installing an infrared security system, which removes the need to illuminate areas as infrared light is not visible.

Site arrangements

Lighting can be arranged on site in a static formation, where lamps are fixed to support poles, masts, or items of plant such as scaffolding and tower cranes. It can also be arranged locally as, and where, work is progressing, using moveable supports or being hand-held with trailing leads.

To illuminate general working areas, festoon (overhead) lighting can be suspended from grids at regular spacings. These should be LED and both cable and lamp holders should be appropriately weather-resistant.

The arrangement should ensure that visual intrusion and light spillage are kept to a minimum, particularly when close to residential properties and busy roads where it may cause nuisance or distraction (Designing Buildings, 2020).

Ensure that staff are suitably trained and place posters around the site to advise staff to turn off lights when a room or area is not in use.



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4.4.2.6 During construction

To avoid unnecessary light pollution from site compounds and/or site offices and cabins:

- a 'switch off' scheme may be implemented
- where security lighting has been installed on and around site, ensure to:
  - only use lighting as required (eg for safety reasons)
  - use an appropriate powered light; for exterior security lighting the maximum is considered to be 2000 lumens or 150w
  - use movement sensors with timers
  - position direct lighting away from sensitive receptors.

4.4.3 Noise and vibration

4.4.3.1 Why these are important

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Noise

Construction noise consists of background noise from noisy plant, material movements, or traffic, direct or indirect noise exposure from tools, and process noise from power tools, piling, lorry traffic etc. **Figure 4.17** presents typical noise levels on construction sites.

Local authority EHOs often receive complaints of excessive construction noise on site. Local planning authorities can use licence conditions to control potential adverse noise effects (DLUHC and MHCLG, 2019). Noise is both a nuisance (to people and ecology) and a health hazard and can disturb and damage wildlife habitats. High noise exposure can cause disabling hearing damage and permanent loss. Noise-induced hearing loss is the second most common reason for occupational health-related employers' liability insurance claims.

CIRIA C693 (Lawrence *et al*, 2011) gives guidance on limits and human susceptibility, and mitigation measures during construction. Standards for Highways (2020) also sets out the requirements for assessing and reporting the effects of highways noise and vibration from construction, operation, and maintenance projects.



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Table 4.2 Typical noise levels of equipment on construction sites

Recommendations	Decibel (dB(A))	Equipment
Double protection recommended >105dBA	112	Pile driver
	110	Air arcing goughing
	108	Impact wrench
	107	Bulldozer/excavator No muffle
	102–104	Air grinder
Hearing protection recommended >85dBA	102	Cran – uninsulated cab
	101–103	Bulldozer/excavator No cab
	97	Chipping concrete
	96	Circular saw and hammering
	96	Jack hammer
	96	Quick-cut saw
	95	Masonry saw
	94	Compactor – no cab
	90	Crane – insulated cab
	87	Loader/backhoe – insulated cab
	86	Grinder
	85–90	Welding machine
	85	Bulldozer/excavator No cab
	60–70	Speaking voice

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Vibration

High vibration levels over a sustained period can cause damage to buildings, while lower vibration levels can cause disturbance, annoyance, and stress to residents. Vibration is similar to noise except that the vibration wave is transmitted through the ground or solid object. Note that health and safety issues related to vibration are out of the scope of this guide.

For more information go to: **https://www.hse.gov.uk/vibration/introduction.htm**

4.4.3.2 Good practice checklists

Noise	✓
Consider adopting working methods and equipment that emit minimal noise. For example: • in demolition works, use hydraulic shears in place of hydraulic impact breakers • when driving steel sheet piles, consider the jacking method (subject to soil conditions, eg cohesive soils) which produce only a fraction of the noise of conventional hammer-driven piling • when breaking out pavements, consider using alternative methods, such as chemical splitters or falling weight breakers, instead of pneumatic breakers and drills	
Consider reducing noisy assembly practices by using off site manufacture	
Keep noisy plant as far away as possible from sensitive receptors	
Adopt working hours to restrict noisy activities to certain less sensitive periods of the day	
Arrange delivery times to suit the area – daytime for residential areas, and night-time for commercial and industrial areas	
Take into account the need to reduce noise and vibration when determining construction vehicles routes	
Keep haul roads well maintained	
Use mufflers or silencers to reduce noise transmitted along pipes and ducts	

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Noise	✓
Minimise the drop height into hoppers, lorries, or other plant **Note that decreasing the drop height by a factor of 10 will reduce noise by about 10 dB**	
Consider using rubber linings on tippers at very sensitive sites	
Liaise with nature conservation bodies to minimise noise disturbance to sensitive wildlife	

Screens	✓
Avoid locations where there are multiple reflections of noise as it may result in increased receptor noise levels	
Erect the screen close to the source(s) of noise or the receptor	
Build the screen from materials with a density of 7 kg/m^2 or higher, with panels stiffened to prevent drumming	
For the most effective results build the screen about 1 m above the highest sight line	
Seal all gaps and openings, including gaps at the bottom of the screen	
Glaze any public observation openings in perimeter hoardings with clear cast acrylic sheet (Perspex®) (protected with wire mesh or similar) if sensitive receptors are lower than the height of the hoarding	
Consider placing more screens close to sensitive receptors but not parallel to nearby walls, unless the screens are absorbent	

Vibration	✓
Consider working methods and equipment that produce less vibration. For example, where practicable: • breaking out concrete should be undertaken using equipment that breaks by bending rather than by percussion • rotary drills and bursters actuated by hydraulic or electrical power should be used for excavating hard material	

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Vibration	✓
Undertake vibration activities as far away as possible from sensitive receptors	
Adopt working hours to restrict high vibration activities to certain times of the day	
Consider fitting suitable anti-vibration mountings to rotating and/or impacting equipment	
Keep haul roads well maintained	
Consider using rubber linings on tippers in sensitive sites	

4.4.3.3 Legal and regulatory requirements

Under Section 61 of the Control of Pollution Act 1974 contractors need to apply for prior consent and agree working hours, site noise levels, and other measures before work begins. Without the consent, the local authority can serve a notice at any point during the works. This applies to England, Wales, and Scotland. In Northern Ireland, the main provisions of the Act are contained in the Waste and Contaminated Land (Northern Ireland) Order 1997.

The Control of Noise at Work Regulations 2005 is the major legislation to ensure that workers' hearing is protected from excessive noise at their place of work. This applies to England, Wales, and Scotland. In Northern Ireland this is under The Control of Noise at Work Regulations (Northern Ireland) 2006.

Councils can serve a notice on people carrying out construction or demolition works and tell them how the work should be done to avoid a penalty notice (Defra, 2017).

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4.4.3.4 Control of noise

Propagation

The level of noise generated from a construction site depends on several factors, some of which can be controlled on site while others rely on local conditions. To manage noise on site, consideration should be given to:

- the noise level of the activity (determined by construction method and plant selection)
- the likely frequency of the noise to minimise the cumulative impact occurring
- level of screening between the noise source and the receiver point
- location of the activity within the construction site.

Selection of noise control should be in the following order.

1 Avoiding excessive noise

All reasonable and practicable steps to minimise noise and vibration should be included in the planning of the construction works.

2 Noise control options

Low noise methods. The best way to minimise the amount of noise is by selecting low noise generating methods. Some construction activities that cause the greatest challenges are:

- piling (particularly by diesel hammer)
- breaking out with pneumatic tools
- scabbling of concrete
- falling ball demolition
- grit-blasting
- hydro-demolition
- high pitched reversing alarms.

Here are some tips:

- avoid percussive piling
- use bending as opposed to percussion methods to break out concrete
- use rotary drills and bursters actuated by hydraulic or electrical power for excavating hard material
- use chemical bursting if nearby sensitive structures are particularly vulnerable to vibration from pneumatic breakers etc
- design routes to avoid/minimise the need for vehicles to reverse.

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Low noise equipment. For many construction activities there are several items of plant that could be used to undertake a particular task. Try to use those are less noisy, for example hydraulic jacking instead of drop hammer. In some circumstances using a single larger item of equipment rather than several small items can reduce noise levels, eg using a single large generator as opposed to several smaller generators.

There are also several ways to reduce the noise of equipment, including:

- ensure all plant and equipment is well maintained and is turned off when not in use
- where activities occur near to sensitive receptors, and especially residential properties at night, consider using 'super silent' generators, mains electricity where possible, and innovative technologies (eg hydrogen fuel cells)
- ensure that noisy equipment is faced away from sensitive receptors, for example piling equipment during impact piling operations.

When selecting less noisy methods, it is important to consider other environmental impacts. For example, hydro-demolition is noisy, but the level of dust produced in comparison to conventional demolition methods is significantly less. So, in certain situations it may be preferable to prioritise the control of dust rather than noise.



3 Modify noise pathway options

Control working hours. For example in residential areas people are more sensitive to noise and vibration in the evening, at night, at the weekend or on a bank holiday, compared to the normal working week. Where possible, works should be limited to weekday daytime only (see also **Section 3.2.4**).

Equipment with acoustic enclosures. Some equipment can be supplied with acoustic enclosures, such as hoods and doors on compressors and generators, or other noise control devices, such as jackets on pneumatic drills and shrouds on piling rigs and cranes. These devices should not only be closed, but also be tight fitting and well-sealed. A partly closed door is of little use.

Appropriate screening. If designed and used correctly, screening can considerably reduce noise levels from a site and at relatively low cost (see **Figure 4.18**). Screening can be provided by existing buildings, earth bunds, site material storage, site security hoarding, purpose-built noise screens or site perimeter hoarding.

Any screening should be placed close to either the source or receiver so that there is no 'line of sight' (see **Figure 4.19**).

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Figure 4.18 Acoustic screening (courtesy BAM Nuttall)

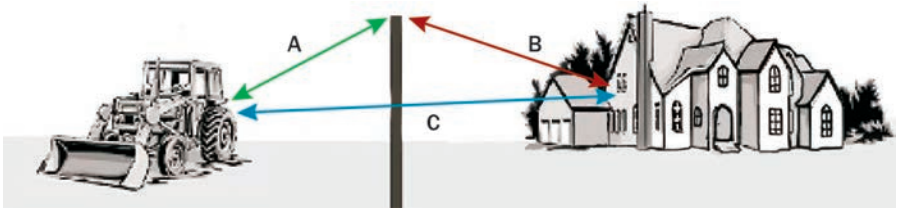


Figure 4.19 Noise screen configuration (midway between source and receiver)

The amount of sound passing through the noise screen is controlled by:

- density of the screen material (ie the higher the density the lower the level of sound passing through the barrier)
- any holes/openings within the noise screen.

The configuration of the screen can be changed to suit individual site requirements, while still achieving maximum noise reduction:

- screen is midway between the source and receiver, but with an increased screen height
- screen is moved closer to the source
- screen is moved closer to the receiver.

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There are several proprietary absorbent noise screens that can be hung from standard Heras site fencing. These have gained in popularity because they are easy to use and can be adapted in a variety of formations as site-specific noise sources change by type or location. Generally, the maximum reduction can be achieved by using a purpose-built screen or site security hoarding.

If noisy activities are to be undertaken near residents for long periods, consider providing residents with protection such as sound insulation to windows, and ventilation at properties, or temporary relocation of residents as a last resort. However, both measures should be implemented only if noise control at source have been exhausted.



Good site management. This includes:

- ensuring that all plant is maintained regularly to comply with relevant national or international standards
- operating plant in the mode of operation that minimises noise emissions
- ensuring that plant is shut down when not in use
- handling all materials, particularly steelwork, in a manner that minimises noise. For example storing materials as far as possible away from sensitive receptors and using resilient mats around steel handling areas
- considering using non-audible warning systems, ie cab-mounted CCTV or the use of banksmen and 'white noise' reversing alarms in place of the usual 'siren' style reversing alert
- appropriate traffic management:
  - reduce works vehicles waiting or queuing on the public highway
  - constructing temporary infrastructure (eg haul roads) using materials that minimise noise and vibration (eg laying a tarmac surface)
  - designing haul routes to minimise the amount of reversing required
  - fitting suitable anti-vibration mountings where practicable, to rotating and/or impacting equipment.

4.4.3.5 Control for vibration

Transmission of vibration is highly dependent on ground conditions and on features in the ground, such as pipe runs. Prediction methods do exist, but they require specialist expertise to implement; they rely on detailed information about the ground conditions and the plant being available on the site.

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If a piling or ground engineering project will generate vibration putting nearby structures at risk, then specialists should undertake a detailed study.

When considering vibration control, the following questions should be asked:

- Can the activity be undertaken using a different methodology that results in lower levels of vibration at the nearby sensitive receptor?
- High frequency vibration causes less damage than low frequency, so can the plant be operated at low frequency (eg vibratory roller, wacker-plates)?
- Can the plant be isolated from the transfer medium (ie what it is sitting on)?
- Can plant be placed on a heavy base, which causes less vibration than plant on a lighter base (eg mount plant on the ground rather than on suspended structures)?

4.4.3.6 Before site work begins

Development of a noise and vibration management plan

As part of the site EMP there should be a noise and vibration management plan, which includes:

- requirements for pre-construction noise and vibration survey to determine the ambient and background levels. This will help to plan the location of site activities that may have noise and vibration issues
- measures to reduce and/control noise and vibration sources. For example, create a one-way system to prevent unnecessary traffic movements
- plans to adopt, communicate, and integrate legal requirements by employing best practicable means (BPM).

Good and early noise and traffic management planning will significantly reduce the risk of construction noise and vibration affecting the overall performance of a project (see **Section 4.6**).

In Part III of the Environmental Pollution Act 1990s, BPM is defined as measures that are *"reasonable and practical having regard among other things to local conditions and circumstances, to the current state of technical knowledge and to financial implications."*



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Pre-construction noise and vibration survey

Before the works start the ambient and background noise and vibration levels at locations around the site should be monitored as part of a survey. The results should be used to plan the location of operations that could cause nuisance to sensitive receptors and help to reduce complaints in the future.

Sensitive locations that needed to be surveyed (and monitored during construction include:

- aquatic habitats nearby
- brittle/ancient underground services including tunnels
- buildings in poor condition
- historic buildings
- hospitals and nursing homes
- housing
- laboratories
- museums
- precision machine workshops
- schools
- sensitive plant or equipment.

Pre-construction vibration survey should include:



- existing cracks and their widths level and plumb survey, including damp-proof course
- measurements of tilting walls or bulges
- other existing damage including loose or broken tiles, pipes, gullies, or plaster.

Photographic records and installation of measuring devices are helpful to establish alleged or actual damage. In some situations, it will be necessary to strengthen vulnerable off-site structures before vibrations start.

If a piling or ground engineering project is likely to generate vibration putting nearby structures at risk, then specialists should undertake a detailed study. In most other situations it should be sufficient for staff to review the operations to take place on site and establish the sensitive areas around the site that may need to be monitored.

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Develop good community liaison

This should be carried out before any noisy works begin (eg letter drops, information on a project website, at local community facilities or available from the local authority) and continue throughout the project. Information should include what activities will be done, mitigation measures on site, the reasons why these works are needed and the duration of activities. There should be close liaison with local authorities particularly the EHO.

4.4.3.7 During construction

Good on-site management

Noise and vibration on site should be managed through:

- proper inspections to ensure the noise and vibration minimising methods, equipment, and mitigation measures identified in the planning stage, are adopted on site and are working effectively (**Figures 4.20 and 4.21**)
- good instruction and supervision of staff
- monitoring to confirm noise level of site activities
- identifying and reporting non-BPM practices, so they can be rectified
- revising working practices to ensure that BPM is adopted at all times
- repeating inspections at regular intervals during the project, but more frequently during particularly noisy activities
- have 'rest periods' when operations are temporarily ceased.



Figure 4.20 Façade noise monitoring equipment (courtesy Arup)



Figure 4.21 Free-field noise monitoring equipment (courtesy Parsons Brinckerhoff)

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A suitably qualified consultant should be appointed to provide technical advice to monitor noise and vibration. All equipment should be calibrated in-line with the requirements of the relevant British Standard or other guidance documents.

It may be necessary for site staff to discuss with building occupants where monitoring can be conducted.



For long-term and possibly unmanned noise and vibration monitoring, extra care should be taken in locating the measurement equipment to minimise both the risk of damage or theft and the influence of other external noise sources, eg fixed building services plant.



Environmental noise and vibration monitoring

- This may be a requirement of the contract and/or a planning permission. According to Section 61 of the Control of Pollution Act 1997, EHO advice should be sought and consent from the local authority should be in place where noise and vibration monitoring needs to take place.
- Monitoring should be undertaken only by suitably trained and experienced staff.
- Monitoring should also be carried out in-line with relevant British Standards, the requirements of a site noise and vibration management plan or EMP, and guidance from ANC (2013). The duration of the monitoring is important. BS 5228-1:2009+A1:2014 suggests that the average noise level over a day can be approximated within certain tolerances by making short-term measurements throughout the day, eg five minutes in every hour.
- Conditions after works are completed should be monitored and the results should be compared to the pre-project survey.

When monitoring vibration during operations, there are two areas that need to be measured:



- inside rooms – the choice of measurement position and extraneous vibration events, such as footfall and the slamming of doors, may affect the measurement results
- the structure outside when assessing for damage (eg doorsteps are in a good location).

Note that vibration measurement is only possible to measure externally at the site or sensitive premises boundary. In which case a transfer function will have to be derived for the local ground conditions, ie an allowance is need for attenuation between ground and foundation and possible amplification at the higher storeys of sensitive premises.

Do not forget that in sensitive structures continued visual monitoring and measurement of crack widths is the best way to determine whether actual damage is being caused.

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Further reading

ANC (2020) *Measurement and assessment of groundborne noise and vibration (Red Book), third edition,* Association of Noise Consultants, Northallerton, UK
www.association-of-noise-consultants.co.uk/publications-guidelines

BS 7385-2:1993 *Evaluation and measurement for vibration in buildings. Guide to damage levels from groundborne vibration*

BS 5228-2:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites. Vibration*

BS ISO 4866:2010 *Mechanical vibration and shock. Vibration of fixed structures. Guidelines for the measurement of vibrations and evaluation of their effects on structures*

4.5 RESOURCE MANAGEMENT

4.5.1 Energy

4.5.1.1 Why this is important

- Machinery, plant, electric tools, lighting, trucks, air conditioning, and heating are all energy consuming sources at construction sites.
- Reducing energy consumption is becoming more important with rising costs worldwide. Fossil fuel is a major contributor to GHG emissions which is driving climate change but is also the major source of energy used in construction projects. Being energy efficient will help the UK reach the 2050 carbon target (see **Box 4.5**).

Box 4.5 Innovation power supply on site

Balfour Beatty has developed a system that can turn off appliances and equipment automatically when not in use. This was applied in the Orbital Route project (a highways contract to build 7km in Leeds) which led to 83% reduction in carbon emission within the first six months of the project.

For more information see Balfour Beatty (2020).

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4.5.1.2 Good practice checklists

Energy efficient housekeeping practices	✓
Switch off equipment and lighting when not required. Be sure that all the switches and controls on machinery are clearly labelled and well understood by all staff	
Ensure windows and doors are closed in cold weather and seals are in good condition	
Make sure site office or cabin are well insulated	
Turn off/turn down heating in unoccupied offices or cabins	
Avoid the unnecessary night-time site and accommodation lighting	
Install energy-efficient lighting, eg LED and motion sensor lights, if appropriate	

Construction plant, machinery, equipment, tools, and site vehicles	✓
Efficient use of machinery and utilities: • select plant with high fuel efficiency • check the mechanical and electrical equipment, such as pumps for utilities, are the right size • conduct regular checks on equipment, machinery, and tool. Report defective seals, electrical equipment, lighting, heating/cooling	
Efficient use of fuels: • select plant based on their fuel efficiency credentials • make sure construction plant is regularly serviced • avoid leaving construction plants to run ‘idle’	

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Delivery and logistics	✓
Make sure there is a good logistical transport system	
If possible, source materials from local areas, or reuse materials already on site or from other projects	
Try to use hybrid and/or fully electric vehicles to minimise emissions and reduce fuel consumption	

Grid connection and renewable energy	✓
Check if the national grid is more energy efficient than relying on power from diesel generators	
Use renewable energy where possible for site operations, eg use solar lanterns to illuminate construction sites, and translucent panels in PV windows to capture solar energy and convert it to electricity	

4.5.1.3 Legal and regulatory requirements

UK legislation, such as The Building Regulations 2010 (applicable in England and Wales), aims to improve energy efficiency performance, and many construction projects tend to focus only on the operation of building. The regulations state that before construction of a new building, the person who is to carry out the work must analyse and take into account the technical, environmental, and economic feasibility of using high-efficiency alternative energy systems, such as renewable sources.

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Approved Document L (HM Government, 2021) provides general guidance on the performance expected of materials and building work to comply with the Building Regulations.



More recently, the UK Government have been asking the construction industry to reduce its energy consumption. This is to ensure the country will cut 78% carbon emissions by 2035 compared to 1990 levels (BEIS *et al*, 2021). This will also provide more incentives to improve energy performance on site.

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4.5.1.4 Before site work begins

Planning

Ensure temporary offices and associated cabins, for example canteens and changing rooms, are well insulated, and the glazing, lighting, and heating are energy efficient. Where possible, use renewable sources such as PV panels (see also **Section 4.4.2**).

Plant and site vehicle selection

- Efficient use of machinery – select the right plant for the job, for example, avoid using oversized or undersized machines that are energy inefficient.
- Efficient use of fuels and use renewable energy – consider using a hybrid, fully electric or biofuel vehicle.
- Select plant based on their fuel efficiency credentials. Details of the fuel consumption should be available from construction plant suppliers. When gaining access to utilities such as water and electricity it is worthwhile checking that the associated mechanical and electrical equipment (pumps etc) are not unnecessarily oversized.
- Ensure that the construction plant is regularly serviced.
- Construction plants should avoid being left to run 'idle'.
- Ensure operators are given advanced training to use plant equipment efficiently.
- Good plant positioning to avoid unnecessary movements.

More can be found on: **www.energysavingtrust.org.uk**

Deliveries and logistic (see also Section 4.6)

- Good site topography and layout should be agreed in the design stage to reduce movement of lorries (and use of fuels in delivery vehicles).
- Encourage car sharing and works minibuses where possible. National logistics companies can provide telemetry services that help to plan deliveries more effectively and give real-time data that can also help arrange backhaul routes for surplus materials and waste removal.
- A good logistical transport system that synchronises the delivery of materials and removal of waste on site reduces time idling for a space to be cleared and products to be offloaded.
- Source material from local areas or reuse materials (on site or other projects) where possible. It is recommended to keep records of volumes of excavated materials that have been reused efficiently on site.

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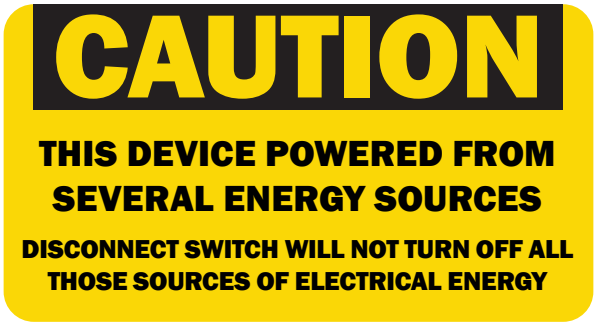
Grid connection and renewable energy

It is considered that the connection of a site to the national grid is more energy efficient than relying on power from diesel generators. Use renewable energy where possible for site operations, for example, solar lanterns to illuminate construction sites, translucent panels in PV windows which capture solar energy and convert it to electric power, and solar hybrid generator.

4.5.1.5 During construction

Practice good housekeeping on site. Energy efficient features of all office equipment including vending machines should be enabled. They should be switch off outside office hours or when not used for a prolonged period of time. Only those with a high energy efficiency rating should be used.

Put up posters and notices to remind site workers, for example:



Metrics and reporting

It is good practice to record energy consumption data for the most significant aspects of the construction as these will not only assist in identifying areas for improvement but serve as evidence to support sustainability assessments such as BREEAM and BREEAM Infrastructure and carbon reporting.

Most large construction companies report to stakeholders on their sustainability performance through an annual report. Site data is often gathered from each project and office to be aggregated up to the corporate level.

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4.5.2 Materials

4.5.2.1 Why this is important

Resource efficiency is important for reducing environmental impact, reducing waste and minimising costs. Increasingly, clients and contractors require monitoring and reporting on resource efficiency. This relates to corporate reporting on carbon, water, waste, and cost. It also helps to ensure materials are being ordered, used, managed, and disposed of effectively. Choosing more sustainable materials can also have social and economic benefits.

Environmental Product Declarations are becoming more common and are important sources of information on specific materials and their environmental impacts.

4.5.2.2 Good practice checklists

Materials procurement	✓
Develop a procurement strategy that considers the environmental life cycle of materials	
If possible, substitute hazardous materials with non-hazardous alternatives	
Order the correct quantity of materials to arrive when they are needed to reduce the required storage time and risk of damage and theft – as part of a just-in-time (JIT) system	
Use products with little packaging or offer take back schemes	
If possible, source ethically produced materials	
If possible, use sustainably sourced materials, such as Forest Stewardship Council (FSC) or Programme for Endorsement of Forest Certification (PEFC) timber, or procure products certified to the framework of BES 6001	
Use materials cut to size to reduce off-cuts	
Consider transport distances of materials, ie are products sourced locally if appropriate	
Discuss opportunities for packaging 'take back' schemes with suppliers	

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Resource efficiency	✓
Where appropriate, replace virgin materials (eg aggregates) with recycled products or reuse material from on site activities (eg temporary works or demolition/deconstruction), lighting systems, boundary fences etc	
Make sure that when considering the reuse of materials on site that they are suitable for the intended use and do not contain contaminants that could potentially cause pollution or harm to sensitive receptors. **Note that a permit/permit exemption or other authorisation (eg CL:AIRE Definition of Waste: Code of Practice [DoW CoP], quality protocol) may be required. If uncertain about the suitability of site materials to be reused seek specialist advice** (see Section 4.5.3)	
Delivery	
Avoid sensitive times for deliveries, eg rush hour, school run	
If possible, arrange take back schemes for excess materials	
Select packaging materials for deliveries that can assist in effective/secure storage and movement of materials on site	
Make sure the appropriate unloading plant has been arranged and space set aside for the materials	
When deliveries arrive on site: • ensure they are off-loaded in a designated area • check goods to ensure that they are the correct specification and quantity • do not accept delivery of damaged goods • ensure they are received by a member of site-based staff who can carry out a quality inspection to avoid waste	
Avoid damage or spillage through incorrect or repetitive handling when handling materials	

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Materials storage	✓
Store all containers of potentially polluting materials (eg oils and paints) in a bunded area	
Store waste in a designated area away from materials storage	
Store materials to guard against breakage, vandalism, or theft	
Store materials in suitable containers that are labelled appropriately with fitted lids, taps, and tops in good condition	
Protect stores against flood damage or inundation	
Designate responsibility for hazardous materials storage, and restrict and manage access	
Clearly mark storage area(s)	
Make sure control measures are in place and/or locate spill kits near to bulk stores and ensure they are accessible and fully stocked	

Managing stockpiles	✓
Store topsoil for reuse in piles less than 2 m high to prevent damage to the soil structure	
Segregate different grades of soil	
Position spoil and temporary stockpiles away from watercourses (minimum of 10 m) and drainage systems	
Minimise movements of materials in stockpiles to reduce degradation of the soil structure	
Make sure silty water formed by erosion of the stockpile is managed correctly	
Direct surface water away from the stockpiles to prevent erosion at the bottom	
Place silt screens around spoil heaps to trap silt from any surface water runoff	
Vegetate long-term stockpiles to prevent dust in dry weather conditions and reduce erosion of the stockpile to form silty runoff. Ensure adequate weed control	

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Refuelling protocol	✓
Designate a bunded refuelling area, away from site drains on an impermeable surface	
Avoid using remote fill points. Where these are unavoidable install suitable oil separators to the surface drainage system	
Avoid refuelling close to watercourses	
When refuelling, keep materials such as absorbent pads or booms readily available in case of spillage	
All refuelling should be supervised. Do not leave valves open and unattended (note that auto-close valves may be a legal requirement)	
Keep an emergency spill kit at each refuelling point. If mobile refuelling is carried out, ensure each bowser carries a spill kit	
Bowsers should have an automatic cut out and should be locked when not in use	
Make sure site staff carrying out refuelling are aware of the refuelling protocol and know what actions to take in an emergency	

Storing materials that contains pollutants	✓
Securely store all containers holding potential pollutants (eg fuels, oils, and chemicals) according to oil storage legislation	
Label containers clearly, so that appropriate remedial action can be taken in the event of a spillage	
Make sure all bulk fuel storage is integrally bunded or kept within a bunded area	
Check taps and hoses for leaks or signs of damage regularly	
Avoid storing drums tightly together; store drums so that they can all be inspected for leaks	
Prevent damage from vandalism, and ensure that all valves and trigger guns are vandal/ tamper proof	
Display signage which requires valves and trigger guns to be locked when not in use	

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Storing materials that contains pollutants	✓
Store tanks or drums in a secure bunded container or compound that is locked when not in use	
Fuel, oil, and chemicals should be stored in containers placed on an impermeable base (this may be part of a bund). If possible, the containers should be stored away from areas of groundwater contamination risk	
Provide separate fill pipes for each tank unless the tanks are interconnected by a balance pipe of greater flow capacity than the fill pipe	
Mark fill pipes with the product type and a tank number where there is more than one tank	
Before moving a drum, check the bung is secure	

Bunding tanks	✓
To avoid accidental spillage, bund tanks with a minimum capacity of 110% of the volume of the largest tank or 25% of the total storage capacity, whichever is the greater: • Do not allow bunded areas to fill with rainwater or slops (ideally, provide a cover). Empty and dispose of any water collected in an appropriate way. • If possible, place tanks away from vehicle movements and mark them clearly so that people know they are a potential risk.	
Do not put tanks where there is a direct link to surface drains, watercourses, or sewers. Avoid placing tanks on unpaved ground, to reduce the risk of groundwater and soil contamination. Protect tanks from vandalism	
Make sure the bund impermeable to the substance that is being stored in the tank	
Position air vent pipes so that they can be seen easily; ensure that they are directed down into the bund to avoid any discharge occurring (eg if the tank overfills)	
Fill points should be inside the bund	
Fit any pumps sited outside the bund with a non-return/check valve installed in the feed line	

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4.5.2.3 Legal and regulatory requirements

The Construction Products (Amendment etc.) (EU Exit) Regulations 2019 came into force on 'exit day' – 31 January 2021. The regime applies to England, Wales, and Scotland but in Northern Ireland, the regulations match the EU requirements for construction products. One of the 'basic requirements for construction works' under the regulations is the sustainable use of natural resources.

4.5.2.4 Environmental impact of materials

Materials selection and their use on site can have many direct and indirect environmental impacts (see **Table 4.2**).

Table 4.3 Example of potential environmental impacts

Virgin material	Direct impacts	Indirect impacts
Timber	• Depletion of resources • Destruction of habitat • Killing of flora and fauna • Release of CO_2 from logging	• Use of fossil fuels to cut trees and transport timber • Waste produced in further treatment and use on site • Emissions (CO_2, NO_x, SO_x etc) in transport • Reduction in biodiversity
Aggregates	• Depletion of finite resource • Pollution during extraction and processing	• Emissions (CO_2, NO_x, SO_x etc) in transport • Waste generated through use

Construction environmental assessment schemes such as BREEAM, BREEAM Infrastructure, Defence Realm Environmental Assessment Methodology (DREAM), and Leadership in Energy and Environmental Design (LEED) consider materials selection to have a significant environmental impact on projects (see **Appendix A2**).

It is good practice to consider the link between material selection, use on site, waste management, carbon, and water. This is referred to as resource efficiency and is the first step towards effective waste management and generating minimal waste (see **Section 4.5.3**).

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4.5.2.5 Materials used on construction sites

Timber

When procuring or supplying material made from timber or timber products, it is important to ensure it is from a legal and sustainable source. Timber certified through either the FSC (see **Figure 4.22**) or PEFC scheme is widely available in the UK.

Several documents are available providing guidance on certain materials used on site, for example, EA (2015b) and EA (2013). The HSE (2021) provides guidance on the safe use of formaldehyde.



Figure 4.22 FSC-approved timber (courtesy Skanska)

To maintain the chain of custody (CoC) schemes, the following information needs to be displayed on the delivery tickets and should be checked upon arrival at site:

- Supplier identification – name and address of the certified supplier providing the timber or timber products.
- Delivery address – usually the project with the main contractor's name.
- Product identification (ie SW linings, oriented strand board sheets, skirting).
- Dimensional quantity of each product supplied and UK Contractors Group (UKCG) member's volume (m^3).
- Date of delivery to site and/or document issue date.
- Formal claim for each certified product (eg FSC 'X' per cent).
- Proof of certification – the CoC number of the supplier (eg BMT-PEFC-1234).

If the timber is physically handled before it is delivered to a project and this person/company does not hold CoC then they are breaking the chain. In this instance the timber should be delivered to the project from a supplier with CoC, or documentary evidence provided to trace the timber back to the source where the chain was broken.

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There are several organisations which provide information on sustainable timber:

Central Point of Expertise on Timber Procurement (CPET):
https://www.gov.uk/government/groups/central-point-of-expertise-on-timber

Forest Stewardship Council *UK FSC and construction*: **https://uk.fsc.org/construction**

Friends of the Earth *Good wood guide*:
https://friendsoftheearth.uk/sustainable-living/good-wood-guide-how-and-why-use-sustainable-timber

Timber Trade Federation:
https://ttf.co.uk/courses/timber-trade-topics/sourcing-sustainable-timber/

Aggregates and cement replacements

The use of recycled and secondary aggregates helps to reduce the demand for virgin quarried materials and can be a cost-effective alternative, particularly with the aggregates levy that is now in place. For more information go to:
www.gov.uk/topic/business-tax/aggregatesp-levy

Of the aggregates used in the UK each year, 70 million tonnes come from recycled or secondary sources, detailed in **Table 4.4**. Upon arrival at the site, it is important to ensure that any secondary aggregates have the correct delivery documentation to show they have met end of waste criteria and their suitability for the proposed use.

Table 4.4 Examples of recycled and secondary sources of aggregate and cement replacements

Recycled	Secondary	
	Manufactured	*Natural*
• aggregate • concrete aggregate • asphalt • asphalt plannings • spent rail ballast	• blast furnace slag • steel slag • pulverised fuel ash (PFA) • incinerator bottom ash (IBA) • furnace bottom ash (FBA) • used foundry sand • spent oil shale • recycled glass • recycled plastic • recycled tyres	• slate aggregate • China clay sand • colliery spoil

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Importation, storage, and placement of recycled and secondary aggregates on site requires an environmental permit, licence, or exemption from the local environmental regulator at all times. However, if the aggregate has been produced in accordance with a quality protocol, for example the *Quality protocol: aggregates from inert waste* (EA, 2013) or meets the requirements of the end of waste criteria, then this is not necessary.

Plasterboard and gypsum

New plasterboard should be stored flat, under cover and away from traffic and moisture to prevent damage to the boards resulting in it becoming waste. It is unlikely that waste plasterboard generated during demolition or refit can be recycled due to contamination and this should be segregated from general waste.

If a take back scheme is not available, then plasterboard/gypsum waste should be separated for recovery and recycling with a registered waste contractor.

Plasterboard and gypsum waste that cannot be recovered or recycled should be sent to landfill. There are currently relatively few landfills that can accept such waste, so this disposal route is likely to lead to higher costs.

Non-hazardous gypsum-based and other high sulphate bearing materials should be deposited in landfills for non-hazardous waste in cells where no biodegradable waste is accepted. Any gypsum-based materials classified as hazardous waste must be disposed of in a hazardous landfill.

Polyvinyl chloride (PVC)

The construction industry is one of the largest consumers of PVC, using it extensively in applications such as piping, cladding, wiring, flooring, windows etc. There are contentious issues surrounding PVC due to the release of toxic substances during the manufacturing process. Recycling PVC can reduce the life cycle impacts of this material.

Formaldehyde

Formaldehyde is most used as a bonding material for composite boards such as MDF and plywood. It is present in insulation materials, glues, and adhesives, and is also used in soft furnishings and carpets, providing a degree of fire retardation.

Exposure to even low levels of formaldehyde (>0.1 ppm in air) through inhalation can cause irritation to the eyes, nose, throat, mucous membranes, and skin. Formaldehyde is classified as a Class 1B carcinogen under The REACH Enforcement Regulations 2008.

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The WEL for formaldehyde set by the HSE (2007 and 2020b) is two parts per million (2 ppm), time weighted average over eight hours and the short-term limit (averaged over ten minutes) is 2 ppm.

Formaldehyde-free and low formaldehyde containing boards and products are increasingly available in the UK and should be specified where possible.

If using formaldehyde bearing products:

- the site air monitoring program should include formaldehyde
- formaldehyde personal monitors may be used by site staff who will be working with formaldehyde-bearing materials
- staff on site should be provided with appropriate PPE
- it should be flagged in the site health and safety plan and appropriate protection measures put in place.

Packaging plays a vital role in materials and product protection, and ease of handling on site – too little increases product waste, too much increases packaging waste. Every effort should be taken to prevent plastics entering the environment.



Reductions can be achieved by:

- appropriately packaged goods for the site requirements
- using materials and packaging recycling and take back schemes
- segregating used packaging materials – most suppliers will be subject to legislative requirements and should be able to offer alternatives if excess packaging becomes waste on site.

4.5.2.6 Before work begins

Planning

A RMP should be prepared before works start and implemented throughout the construction process.

Material procurement and sourcing

Considering the environmental impact during the procurement of materials has many benefits for the site. A procurement strategy should be in place that can be applied on each development site. Such a strategy should consider:

- substituting virgin materials with those with recycled content to achieve a circular economy (see **Section 4.5.3**)
- procuring reusable materials such as shuttering, hoarding, and fencing (see **Section 4.5.3**)

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- substituting hazardous materials, such as PVC, with non-hazardous alternatives (ie less pollution potential, safer to use for employees, and easier and cheaper to dispose)
- ethically and/or sustainably sourced materials and products, for example FSC and PEFC certified timber, BES 6001, Ethical Trading Initiative (ETI) and Global Reporting Initiative (GRI)
- locally sourced goods where appropriate
- the embodied energy, CO_2 and waste of materials when selecting products (as part of assessing the whole-life impact of the project) (see **Section 4.5.3**)
- JIT delivery options and avoid over ordering to reduce wastage and damage at the site (particularly if there is inadequate storage space)
- using competent suppliers and contractors, ie those with accreditations such as the Contractors Health and Safety Assessment Scheme (CHAS), recognised management systems such as ISO 14001, no incidents or prosecutions, and have good references and continued good service.

The materials should be delivered according to the plan developed within the procurement strategy. If the materials delivered are recorded using a digital system, such as scanning bar codes and/or QR codes, the data should be downloaded and stored in the BIM.

BRE (2009) provides further guidance.

It is important that site staff are informed regarding potential hazards associated with materials being use on site.



Reuse of materials on site

Be aware of the potential to reuse existing materials on site, for example, construction products from existing buildings, such as fencing and shuttering; hardcore and waste concrete can also be used for landscaping or footpaths.

Specific requirements may be needed to use excavated soils, which may be subject to an environmental permit and/or waste licence, permit/waste licence exemption or be covered by a regulatory position (see **Section 4.5.3**).

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The CL:AIRE DoW:CoP is a voluntary industry code of practice for the reuse of soils and other excavated materials on the site (eg for raising ground level or for general landscaping) in England and Wales.

4.5.2.7 During construction

Storing materials

It is important to manage storage areas on site efficiently (**Figure 4.23**) to reduce the risk of environmental damage (eg water pollution), injury to site-based staff and theft. When storing materials keep the following points in mind:



Figure 4.23 Example of tidy and safe storage of materials (courtesy Laing O'Rourke)

- ensure that the suppliers' instructions are being followed
- plan the storage area so that frequently used items are easy to access
- store valuable materials and those containing hazardous or potentially polluting substance away from the public
- all potentially polluting materials should be stored in a designated area, on an impermeable base, bunded and away from potential vehicle collision. Protect storage areas from the elements to minimise risk of pollution (ie silty runoff) or being spoiled, and away from sensitive receptors (eg watercourses) including drainage and transport routes, if there is no vegetated buffer zone
- store materials away from waste storage containers and from vehicle movements that could cause accidental damage
- secure lightweight materials to protect them from wind damage or loss
- storage and use of perishable items (eg bags of cement) should follow the 'first in first out' rule
- store materials away from watercourses and drains to avoid pollution from spillages.

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Managing materials

Different materials need to be managed in different ways according to their potential environmental impacts and legal requirements. Materials that are potentially hazardous, such as adhesives, solvents, paints, and curing agents, are regulated under COSHH 2002, which also provides details of how these materials must be stored, used, and disposed of in a series of datasheets. These datasheets should be followed and an inventory of all COSHH materials held on site should be maintained and included in the BIM. As a minimum all COSHH materials should be kept in a secure bunded COSHH store located away from drains and watercourses (see **Figure 4.24**).



Figure 4.24 COSHH store sign (courtesy Laing O'Rourke)

UK-specific guidance for oil storage:

England and Wales: **https://www.gov.uk/guidance/storing-oil-at-a-home-or-business**

Scotland:
https://www.sepa.org.uk/regulations/water/pollution-control/oil-storage-in-scotland/

Northern Ireland: **https://www.daera-ni.gov.uk/articles/oil-storage**

How to prevent damage

Consider the appropriate means to physically handle products/materials to prevent them being damaged and becoming waste. For instance, store on pallets in designated areas and protected from the elements (eg wind and rain).

Handling

Handling of materials on site should be kept to a minimum to avoid the risk of damage and/or injury to site-based staff. Whether using cranes, trucks or forklifts, or manual handling will depend on the nature of the work. All manual handling should be risk assessed and staff should have appropriate training. Ensure that the suppliers' instructions on their operation are always followed.

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Stockpiling

For any stockpile (see **Figure 4.25**) that will be used on site for a long period, it is worth considering profiling and vegetating it to improve its stability and aesthetics (to avoid nuisance from dust). Here are some tips on good practice:



Figure 4.25 Landscaped stockpile of spoil (courtesy Galliford Try plc)

- Ensure control measures are in place to deal with silt runoff during wet conditions and dust during dry periods.
- Stockpiles or areas of exposed soil should be managed to prevent silty runoff from entering watercourses, drains, public highways, and areas of the site where materials are stored. This can be done through bunding, vegetation, silt fencing and the use of cut-off trenches, berms, bunds, and coverings (eg hessian or jute matting).
- Materials such as uncontaminated spoil arising from site set-up, sands and gravel excavations can be used to create a temporary bund or acoustic barrier while works are in progress and minimise silty runoff. Where the bund or barrier is situated, careful consideration is needed to ensure environmental permitting requirements are met.

See also **Section 4.3**.

Consider the need for an environmental permit, licence, or waste management exemption.

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4.5.3 Resource efficiency and waste

4.5.3.1 Why these are important

The move towards a circular economy is being made by many governments worldwide as it contributes to the reduction of GHG emissions (**Figures 4.26 and 4.27**). Keeping construction materials at their highest value and avoiding downcycling (loss of value of the resource) is one of the key principles of the circular economy, but the construction industry struggles to deliver.

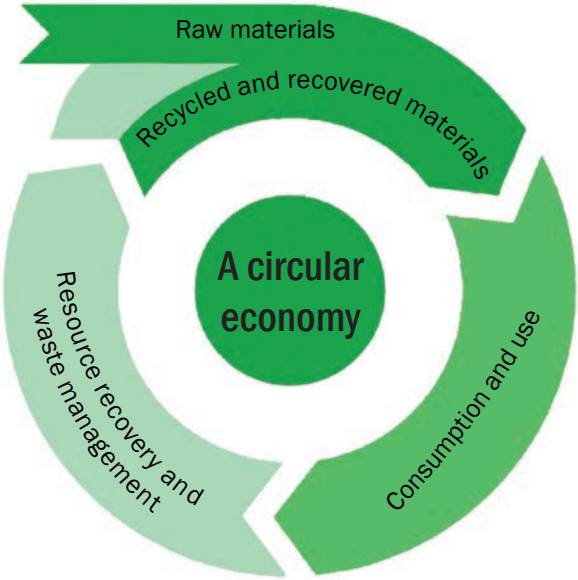


Figure 4.26 Circular economy model (from HM Government, 2018b)

The construction industry was responsible for 62% of all UK waste, generating up to 138 million tonnes of construction, demolition, and excavation waste of which about 34 million tonnes was sent to landfill in 2018 (Defra, 2022b).

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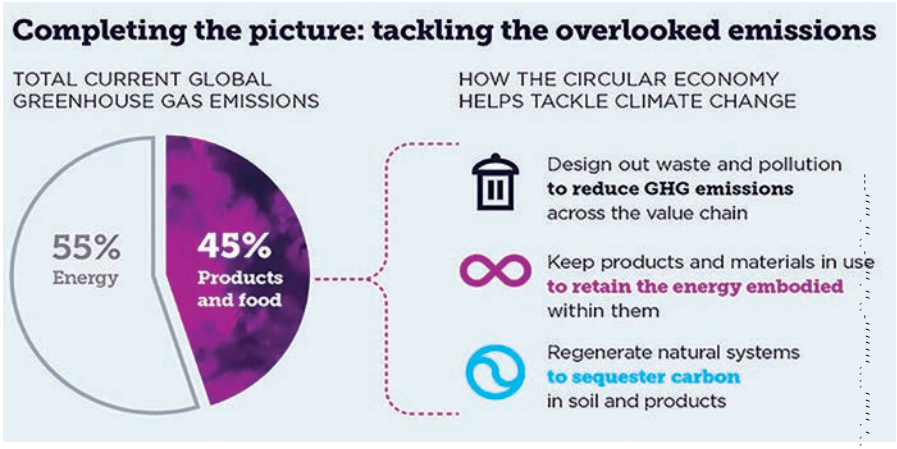


Figure 4.27 Relationship between circular economy and climate change (from Ellen MacArthur Foundation, 2020)

The construction industry needs to improve resource efficiency, ie creating more from less and reduce consumption while minimising impacts on the environment. There is synergy with the Waste Hierarchy (**Figure 4.28**) which sets a clear objective to prevent waste and to avoid landfill through design, reuse, recycling, and recovery.

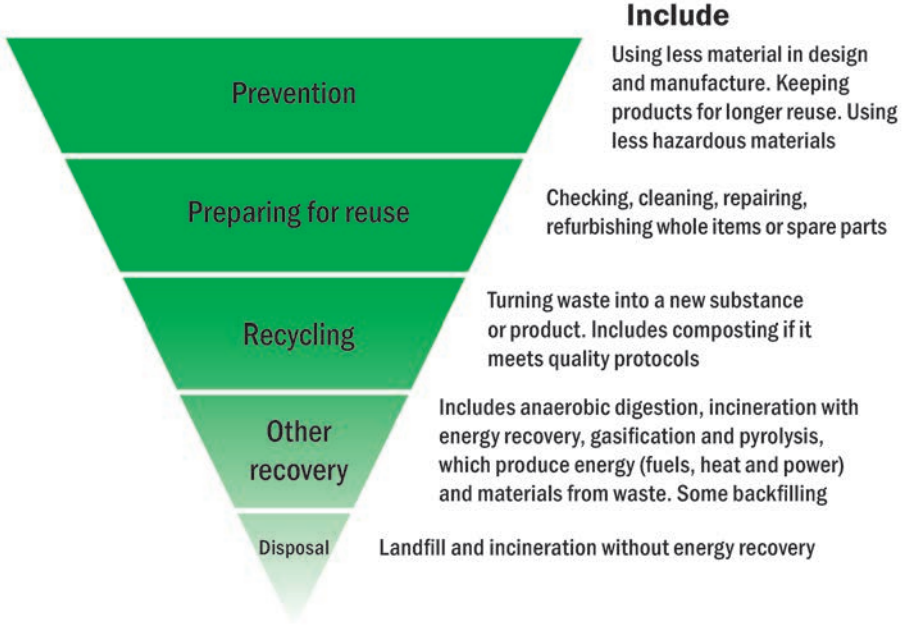


Figure 4.28 The Waste Hierarchy

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Waste not managed properly can cause health, environmental and nuisance issues, cost time, money, effort, and lead to carbon emissions. It also encourages waste crime – illegal waste activity not only costs the UK financially (estimated in 2018/2019 at over £924M in England alone) but also gives the construction industry a negative image and may result in fines and criminal convictions to construction companies (see **Figure 4.29**).



Note that these are estimates of the value of different waste crimes in England and their cost to society.

Figure 4.29 Value of waste crime in 2018/2019 (after ESA, 2021)

Also, errors in the construction industry further increase the quantities of wasted materials and energy and are estimated to cost between £10 and £25 billion per annum across the sector (GIRI, 2019). Construction project errors include:

- lack of attention to quality
- inadequate supervisory skills
- poor decision making by not involving the right people at the right time due to the complexity of many construction projects and the number of different professional disciplines involved in their delivery.

These can all be corrected by improved site practice.

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In addition if waste goes to landfill, all four UK jurisdictions charge a landfill tax (see **Section 4.5.3.11**). Other costs include landfill gate cost, waste, transport etc.

Typically, companies with environmental corporate social responsibility business strategies, which include sustainable resourcing and decreasing waste, have a good reputation, staff retention, and brand value.

Early consideration of waste in the construction process provides more opportunities to design-out waste and/or find alternative uses for surplus materials. Reducing construction waste going to landfill is also essential to achieving net zero carbon.

Waste is *"any substance or object which the holder discards or intends to discard or intends or is required to discard"* (Defra *et al*, 2021). This can include materials that other people want, or for which they can find a beneficial use.

Due to the wealth of legislation across the four UK jurisdictions covering waste management the challenges of deciding 'what is a waste', and when 'a waste ceases to be a waste' is complex. It is often necessary to seek professional advice and consult the relevant regulator to ensure legal compliance. Using checklists, a SWMP can also help deliver good practice. For further guidance see GCB and CLC (2021) and Berryman *et al* (2022).

4.5.3.2 Good practice checklists

Before starting on site – planning	✓
Check waste minimisation and resource efficiency targets/KPIs set by local authority/planning permission, the client, contractor, or organisation are included in the SWMP/RMP	
Check if the SWMP/RMP has included all waste streams (types and quantities) with an appropriate action plan and appropriate costs	
Update SWMP/RMP with cost estimates for waste expected	
Identify and appoint a competent responsible person for implementing and monitoring SWMP/RMP during site works	
When undertaking demolition works, there should be a pre-demolition audit to identify the best options for waste minimisation and resource efficiency (ie reclaiming as much waste as possible and the least downcycling)	
Consider the need to test materials (eg timbers, paints and coatings for hazardous properties) before demolition starts	

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Before starting on site – planning	✓
Review expected waste and disposal options with client, designers, and/or architects. Agree actions to reduce expected wastes using the Waste Hierarchy (including where specifications will allow the use of reclaimed/recovered materials)	
Make sure the relevant consents and permits/licences are in place	
Consider additional testing and surveys to identify the extent and nature of contamination if needed	
Procure specialist contractors and suppliers to implement the waste action plan (eg remediation contractors, salvage companies, waste treatment facilities)	
Make sure sufficient space is allocated on site to meet waste management requirements. If this is not possible, find an off-site contractor with a materials recycling facility	
Define facilities on site for requirements of SWMP/RMP and locate them in areas with the least risk of nuisance and pollution (include details in the EMP)	
Make sure that there is a joint commitment to the waste management plan/SWMP with the client	
Make sure signage for skips are clear (consider using a colour code system) and update signs to reflect the site, eg company name, contact details, waste transfer evidence	
Make sure staff undertaking waste management roles have suitable training, for example training required for staff producing on-site recycled aggregate to meet the relevant quality protocol	
Make sure SWMP/RMP requirements are included in induction material and site contractors as well as subcontractors understand these requirements	
Make sure site staff are briefed on which subcontractors should be present to cover waste management issues	
Designate quarantine area(s) for dealing with unexpected waste, for example ground contamination and/or imported materials that require testing before disposal/use respectively (eg manufactured topsoil)	

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During construction	✓
Include waste management and resource efficiency on agenda for progress meetings	
Use JIT deliveries aligned to appropriate stages of work to avoid the risk of damage from poor storage	
Avoid over ordering, particularly time-sensitive materials like concrete	
Reject materials that have been damaged in transit	
If possible, reduce packaging and/or arrange to return to supplier	
Check if the import 'products' from waste have the correct documentary evidence that they have achieved end of waste status	
Track what materials are arriving on site and what is leaving to highlight waste rates. Feedback and address any poor performance	
Carry out waste audits, which can help check for compliance, and record keeping as part of robust duty of care, and in meeting other obligations such as verification reporting required by planning conditions	
If possible, design/select temporary works that can be incorporated in permanent works or deconstructed for reuse	
If possible, return, sell, or donate (eg to community projects) unused paint or materials	
Track and record all material movements and compliance with duty of care and monitoring requirements	

Storing waste properly on site	✓
Segregate waste. Make this easy for site-based staff to do, by providing several waste containers in a designated impermeable waste storage area and briefing staff on their requirements	
Mark waste containers clearly with their intended contents	
Use containers suitable for their contents. Check that containers are not corroded or worn out	
Use covered skips to prevent spread of wind-blown wastes	
Store away from drains and other environmental receptors	

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Storage of hazardous waste	✓
Check that the premises are registered as a producer of hazardous waste (eg if more than 500 kg is likely to be generated – in Wales only)	
Make sure hazardous wastes are stored in suitably labelled containers away from sensitive receptors and the risk of damage by site traffic	
Do not mix hazardous waste with non-hazardous waste	
Do not mix different types of hazardous waste together	
Do not store wastes longer than is necessary to complete documentation and arrange for their disposal	

Handling and removing waste (on a confined site)	✓
If possible, use roller bins when removing waste from upper levels on buildings	
If possible, store bins in an area close to lifts	
If possible, arrange for daily collection of bins	
If possible, lower bins to ground floor only shortly before the collection lorry arrives	

Duty of care --````,,``,`,,,,,,````,,,,,,,,-``,,`,,,,-``,,`,,,,---	✓
Check that a valid copy of the waste carrier/dealer/broker registration showing the correct tier is available on site. The registration certificate/ permit should only be accepted if it has been endorsed by the appropriate environmental regulator, ie it is available online via public registers	
Check if the waste carrier is registered	
Check if the transfer notes are completed in full and contain an accurate description of the waste, full LoW code, and signed by the producer and carrier, before it leaves the site. Also includes SIC code and waste hierarchy declaration	
Keep copies of all waste transfer evidence for waste sent off site for two years for inert and non-hazardous	

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Duty of care	✓
Record hazardous waste movements on consignment notes and copies kept for three years	
Carry out spot checks to ensure compliance with the duty of care. This includes: • following the waste carrier to ensure the waste arrives at the agreed disposal site • carrying out periodic assessment and/or audits on the waste carrier • visiting the waste carrier's premises • visiting/assessing agreed disposal site to confirm it is licensed/ permitted to accept the waste	

Monitoring and reporting waste	✓
Update SWMP each time waste is removed from site (using transfer and consignment note records)	
If operating a permitted or licensed waste activity on site, ensure volumes/ types of material covered by the authorisation are recorded. Do not exceed the limits set by the permit/licence	
Undertake monthly review of performance against the waste action plan, including targets, and update records	
Report performance internally against the action plan and seek improvements if required	
Provide data where necessary to allow completion of verification reports, and identification of any residual hazards for the health and safety file, for example where soils containing contaminants have been reused on site	
Complete a performance assessment at the end of a project, including expected against actual waste generated, disposal, cost of disposal, and any savings achieved	

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4.5.3.3 Waste regulators

Waste regulation is the responsibility of the relevant regulator:

- England: Environment Agency
  - Waste – detailed information: https://www.gov.uk/topic/environmental-management/waste
  - Definition of waste service: https://www.gov.uk/government/publications/get-an-opinion-from-the-definition-of-waste-service/how-to-use-the-definition-of-waste-service
  - Waste crime: https://www.gov.uk/report-an-environmental-incident
- Wales: Natural Resources Wales
  - Waste management: https://naturalresourceswales.gov.uk/guidance-and-advice/environmental-topics/waste-management/?lang=en
  - Waste crime: https://naturalresources.wales/about-us/contact-us/report-an-environmental-incident/?lang=en
- Scotland: Scottish Environment Protection Agency:
  - Waste: https://www.sepa.org.uk/regulations/waste/#:~:text=licence%20and%20monitor%20waste%20management%20facilities%20such%20as,of%20wastes%3B%20respond%20to%20pollution%20incidents%20and%20fly-tipping.issing
  - Waste crime: https://www2.sepa.org.uk/EnvironmentalEvents
- Northern Ireland: Department of Agriculture, Environment and Rural Affairs
  - Waste: https://www.daera-ni.gov.uk/topics/waste
  - Waste crime: https://www.daera-ni.gov.uk/contacts/environmental-crime

4.5.3.4 Legal and regulatory requirements

Waste legislation aims to ensure:

- disposal of waste is regulated (and traceable)
- the waste producer bears the cost of waste disposal, in line with the polluter pays principle.

Key legal requirements that construction sites generating waste should follow are discussed here.

The Waste Hierarchy

Legislation states that waste management priorities and practical actions on site must follow the principles of the Waste Hierarchy (**Figure 4.30**). A declaration

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that this has been applied should be included on the relevant duty of care documentation when transferring waste.

Duty of care

Ensure that waste is managed safely in a manner that prevents harm to people and the environment and prevents the waste from falling into unregulated or 'cowboy' waste carriers who will dispose of the waste illegally.



There is a duty of care to ensure that waste is dealt with appropriately. It applies to anyone who imports, produces, carries, keeps, treats, disposes of or, as a dealer or broker, has control of certain waste.

Waste holders are required to take reasonable steps to prevent:

- unauthorised treatment and disposal
- a failure of others to comply with their permits/licence and related conditions
- waste from escaping

and to ensure waste is described accurately before being transferred to an appropriate person.

Actions needed on site include:

- keeping a record of the waste that has been transferred to and from the site
- only using a registered waste carrier to transport waste to or from the site, and provide a colour copy or electronic copy of their waste carriers' certificate
- checking the public registers to ensure inclusion of (see **Section 4.5.3.6**):
  - waste carriers
  - waste permit/licences or exemption if the authorisation at the destination site is covered by one
- if working under a regulatory position or, for example, in England and Wales under the CL:AIRE DoW CoP, checks should made directly by requesting compliance evidence from the receiving site (planning permission, approved remediation strategy, submitted declaration etc)
- staff training, using good practice checklists and a SWMP/RMP, to assure that the duty of care requirements are met.

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Waste should only be accepted at authorised sites and comply with any conditions associated with that authorisation. Always obtain a copy of the permit, licence, or exemption which provides details on what can be accepted, including the types of waste and the volumes of that waste.

Disposal at unauthorised sites may be subject to landfill tax (at the standard rate; or in Wales 150% of the standard rate) and a fine (up to a value of 100% of the landfill tax). For example, waste that has been sent to the wrong place due to misclassification could be considered disposal at an unauthorised site.

Any party involved with disposal could be liable.

Guidance on duty of care is available in England – Defra and EA (2018), Wales – NRW (2021), Scotland – Scottish Government (2012), and Northern Ireland – NIEA (2016).

Many types of hazardous waste can be recycled (eg oil and solvents). Identifying potential recycling and reuse opportunities early will enable hazardous waste to be better managed both in terms of cost control and environmental impact.

Hazardous wastes can be accepted only at a particular hazardous waste landfill if they meet the relevant WAC for that class of landfill and the waste acceptance procedures (WAP) are followed.

Hazardous waste can also be incinerated. Incineration plants operate under strict environmental permits so it is important to find out what hazardous waste can be accepted.

Registering premises producing hazardous waste (Wales only)

In Wales, there is a legal requirement that NRW must be notified of premises where more than 500 kg of hazardous waste will be produced in a year. Such sites must be registered with the NRW. Once a site is registered it will be assigned a unique six-digit code that needs to be put on all consignment notes.

End of waste status

Article 6 of the WFD sets out the tests for when a waste is considered to reach its end of waste status and be considered a 'product'. Commonly made products from waste have published national end of waste protocols, for example aggregates from inert wastes.

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If a product from waste does not entirely comply with the relevant end of waste protocol or can demonstrate it has met end of waste status then it is still considered to be waste and may be subject to the full spectrum of waste legislation. For examople, if it is placed while still a waste without appropriate authorisation the area of placement may be considered an unauthorised landfill site and be subject to enforcement action.

There are no end of waste protocols for manufactured soils from waste and an appropriate waste authorisation (ie permit, licence, or exemption, or it meets the terms of a regulatory position) will be required for use on site.

Environmental permitting/licensing

In England and Wales, legislation requires 'waste operations' to hold an environmental permit or have an exemption. Waste operations mean any recovery (**including storage pending recycling/reclamation etc**) or disposal of waste that requires an environmental permit – unless the operation is specifically exempt or excluded under the legislation.

In Northern Ireland and Scotland waste operations will be authorised by a waste management licence, an exemption from waste management licensing, or a pollution prevention and control (PPC) permit, depending on the nature of the waste management activity.

For all countries in the UK, it is important to identify whether an environmental permit or licence is required for operations on or off site. Note that for some low-risk activities a regulatory position statement may be available.

4.5.3.5 Waste description and classification

A waste description should contain all information necessary to enable it to be handled, transported, treated, recovered or disposed of legally and safely.

All waste assessment and classification must be undertaken in accordance with relevant version of Technical Guidance WM3 for each UK jurisdiction, to ensure that the correct LoW code is assigned.

Remember WAC cannot be used for waste classification.

Waste description includes the classification of the waste as hazardous ('special' in Scotland) or non-hazardous with inert being a sub-classification of non-hazardous. The LoW is used to identify waste and assigns a six-digit code which is required on waste transfer evidence.

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To code a waste and classify on the LoW, first determine if the waste is a 'mirror' or 'absolute' entry on the LoW.

If it is an 'absolute' hazardous entry then the waste must be treated as hazardous. If the waste is a 'mirror' entry, further assessment and classification works need to be undertaken to determine whether the waste is hazardous or not in accordance with Technical Guidance WM3.

Wastes that do not possess an absolute hazardous or mirror entry are classed as non-hazardous, or inert wastes. The latter is wastes that may be assumed to fulfil the criteria set out in Article 2(e) of the Landfill Directive or meet the inert WAC criteria. This is important as site managers are responsible for ensuring that waste transfer forms or hazardous waste consignment notes (HWCNs) are completed with the correct code.

Waste classification is complicated for substances such as excavated arisings, which are not clean and naturally occurring. A key issue with describing waste soils is ensuring the different types of soil have been identified, adequately sampled, tested, and assessed to enable appropriate descriptions to be assigned. For more information go to Appendix D of Technical Guidance WM3.

Landfill disposal

Construction wastes that can be accepted in landfills include:

- **Inert waste** – for example rock, ceramics, concrete, masonry, and brick rubble.
- **Non-hazardous waste** – non-contaminated biodegradable materials including paper, cardboard, plastic, metal, timber, topsoil, and food.
- **Hazardous/special (Scotland) waste** – contaminated and harmful materials that are dangerous to life and/or damaging to the environment. Hazardous wastes may be corrosive, explosive, oxidising, carcinogenic or flammable, for example asbestos, acids, alkaline solutions, oily sludges, waste oils and wood preservatives.

4.5.3.6 Movement of waste

To transport controlled waste, a waste carrier must be registered with the regulator (EA, NRW, SEPA, NIEA). The following public registers should be used to check if the waste carriers are registered:

- England: **https://environment.data.gov.uk/public-register/view/search-waste-carriers-brokers**
- Wales: **https://naturalresources.wales/permits-and-permissions/waste-carriers-brokers-and-dealers-public-register/?lang=en**
- Scotland: **https://www2.sepa.org.uk/wastecarriers**
- Northern Ireland: **https://www.daera-ni.gov.uk/articles/registered-waste-carriers-transporters**

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There are two tiers of registration, the upper tier registration is required for anyone carrying construction and demolition waste as well as brokers and dealers. Waste carriers and/or brokers registered in England, Scotland or Wales can operate in any other country in Great Britain; in Northern Ireland a separate registration would have to be made with the NIEA.

Chain of custody forms

- **Waste transfer evidence/notes (inert and non-hazardous waste).** All inert and non-hazardous waste leaving the site must be accompanied by waste transfer documentation referred to as a waste transfer note (WTN).

  All four jurisdictions provide example WTNs, but there is no standard documentation and contractors often produce their own versions. Care needs to be taken to include the following information for controlled waste:

  - description of the waste
  - treatment processes the waste has been through
  - LoW (formerly European Waste Catalogue [EWC] code)
  - how waste is contained
  - quantity of waste
  - place, date, and time of transfer
  - name and address of the waste holder/producer (transferor)
  - name and address of the waste receiver (Transferee)
  - details of the waste carrier registration, permit, licence, or exemption of the person receiving the waste
  - declaration that the Waste Hierarchy has been applied (England, Wales, and Northern Ireland only)
  - SIC code (2007)
  - signatures of both parties (transferor and transferee).

  Copies of waste transfer evidence needs to be kept by the waste producer, carrier, broker (if applicable), and disposer. These records need to be kept for a minimum of two years.

  An electronic alternative to the existing paper-based system of waste transfer evidence and WTNs is also available. The electronic duty of care (edoc) programme is a national, internet-based system to monitor the collection, transport, and disposal of waste materials. It was designed to make it easier for businesses and regulators to collect, collate, and extract good quality waste transfer data. See EA (2015).

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Waste transfer note (WTN) records the transfer of waste between two parties. It does not record the full journey of the waste and there is no requirement to include the site of final disposal or recovery unless that is where the transfer takes place.



Companies are required to take (reasonable) action to confirm their waste has been managed legally once it leaves their site. Many companies even choose to follow waste from their site to confirm it has been taken to an exempt, permitted or licensed waste management facility for treatment or disposal.

- **Consignment notes – hazardous/special waste.** All hazardous/special waste leaving the site must be accompanied by a HWCN in England, Wales, and Northern Ireland, and a Special Waste Consignment Note (SWCN) in Scotland, which travels with the waste to its final treatment or disposal option.

  The following information must be included on a HWCN or SWCN:

  - consignment note code or number (in Scotland a SA, SB or SC code must be purchased from and issued by SEPA and in Northern Ireland must be obtained from NIEA)
  - hazardous waste premises code (in Wales)
  - description of the waste
  - how the waste is contained or packaged
  - physical form of the waste
  - quantity of the waste
  - hazardous properties associated with the waste
  - chemical/biological components of the waste
  - place and date of transfer
  - name of the person or organisation that produced the waste (consignor)
  - name of the person or organisation that is moving the waste (consignee)
  - waste carrier's registration number
  - details of the permit, licence or exemption of the person receiving the waste
  - appropriate LoW code for the waste
  - SIC of the producer of the waste business (England, Wales, and Northern Ireland only)
  - confirmation that the Waste Hierarchy has been applied (England, Wales, and Northern Ireland)
  - signatures of both parties (the consignor and the consignee).

  Copies of the consignment note need to be kept by the producer for at least three years.

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In England and Wales, the consignee (the person whom waste is transferred to for recovery or disposal) issues records to the site (consignor) of the waste disposed, including copies of consignment note and information on waste received, disposed, or recovery of waste (known as quarterly returns). These returns must be retained by the holder at the registered site, or registered office after the site closes.

Pre-notification for the movement of hazardous waste

To move hazardous waste in Northern Ireland:

- pre-notification is required
- if an organisation is using its own forms, a uniquely coded consignment number must be obtained from the NIEA
- there is a small fee for numbers prefixed by the letters DA and DB
- prefixes are determined by waste type.

In Scotland, some special waste movements are required to be pre-notified to SEPA using the top white sheet from the coloured coded consignment notes that can be obtained when purchasing the unique code for the shipment. For example, moving waste from outside of Scotland into Scotland, or moving waste from Scotland to a site for recycling, treatment, or disposal situated outside Scotland.

4.5.3.7 Before site work begins

Figure 4.30 outlines the activities to apply waste management on site. The following section explains this process in more detail.

Planning

Considering waste management and resource efficiency early in the project will increase the available options, including looking for opportunities to design out the generation of waste and, where possible, alternative uses for waste materials. SWMP should involve all parts of the project team, including the client, contractors, designers, and workers.

Waste and resource efficiency is often an LPA matter; planning conditions could include:

- Requiring an SWMP/RMP (these documents are a useful waste management tool, considered good practice, often required by the client or main contractor, or to obtain BREEAM points).

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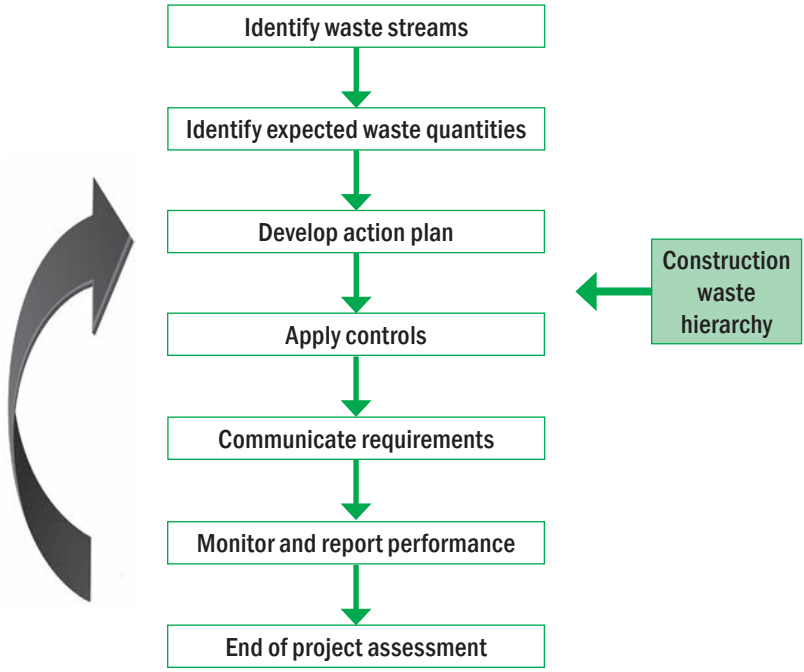


Figure 4.30 Application of waste management on site (courtesy Bureau Veritas)

- Setting targets to minimise materials being sent to landfill or for resource efficiency.
- Agreeing on a remediation strategy that, for example, controls what concentrations of contaminants can be present in materials to be reused. Records need to be kept of material movements for a verification report conditioned under the planning permission.

The following useful tips should be noted.

- Ensure the waste management and resource efficiency obligations and aspirations, as well as reporting and monitoring requirements, are understood.
- Check that all necessary consents, permits/licences etc are in place.
- Identify the waste stream expected to be encountered and have an action plan ready (usually contained in the SWMP/RMP). Various templates and tools are available online to assist with identifying and forecasting construction wastes.

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- Ensure programme and logistics planning take account of the waste management constraints including:
  - co-ordination and handover of any areas of the site that require demolition/remediation before the main construction works
  - identifying sufficient space for on-site waste management activities (where not available identifying alternative off-site management options).

Note that many product suppliers offer take back schemes for packaging and/or left over product reducing unnecessary waste on site.

- **Appoint a competent person.** Before the construction stage the contractor should appoint a waste management and resource champion to oversee the process.

  Due to the complexity of waste management, there may need to be additional competent persons/organisations employed for different waste activities.
- **Provide adequate training for site staff.** All staff should attend a site induction where they will be informed of the waste management procedures and any special precautions for dealing with hazardous waste materials that may be encountered. For example, this could include PPE and training (eg under Regulation 10 of CAR 2012 for asbestos) on how to segregate and store both wastes and materials coming onto the site.
- **It is good practice for the principal contractor to make the SWMP/RMP available to all contractors.** Sometimes it is a client requirement, for example for National Highways contracts the principal contractor is required to ensure all contractors/employees are aware of their SWMP/RMP.



Toolbox talks are an excellent on-site tool for use in informing and/or educating site staff.

CIRIA's environmental toolbox talks are free to download from:
https://www.ciria.org/CIRIA/Resources/Toolbox_talks.aspx

The Supply Chain School's Waste and Resource Use Group provides initiatives and learning materials from:
https://www.supplychainschool.co.uk/partners/groups/waste-group/

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4.5.3.8 During construction

General site management

Good site management includes:

- Rejecting out of specification and/or damaged materials – return to supplier so they do not become site waste.
- Specifying/negotiating a reduction in the amount of packaging used by suppliers or using packaging return schemes.
- Storing materials correctly to avoid them becoming damaged and ending up as waste.
- Where possible, using JIT processes that align with construction activities to reduce over-ordering.
- Collecting and using off-cuts.
- Facilitating the reuse of materials between trades.
- Considering the use of reused and recycled materials on site (assuming allowed by the specification/contract). To find sources of such materials talk to local demolition contractors and local authority recycling officers.
- Confirming waste segregation procedures including measures to prevent contamination, and what can be placed in a general mixed waste (non-hazardous) skip.
- Consider returning, selling, or donating unused and salvaged materials, for example, local charities may take spare paint. Use resource/waste exchange platforms to connect those with surplus materials with others who require such materials. For example, Resource Efficient Scotland's *Construction Material Exchange* and CL:AIRE's *Register of Materials*.
- Reporting waste crime, eg fly tipping.

Waste management should be an ongoing topic at progress meetings with feedback on what is going well and what could be improved.



Segregating waste streams

- Wastes types should be segregated.
- Segregate at the point of production to maximise recovery and recycling of construction wastes.
- Allocate space for segregation and areas for quarantining/securing any suspect and/or hazardous materials where risk of nuisance/pollution is very low/negligible.

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- Clearly mark areas on site plans for waste management purposes.
- Storage areas should have clear signage.
- Where space allows, skips for various waste streams should be included, for example gypsum, wood plastics, metals, glass, paper, and card (see **Figure 4.31**). Consider ICE generic waste management colour scheme to help with on-site compliance. Note the colour scheme refers to colour of labels although skips could be painted relevant colour:
  - white: gypsum and plasterboard products (take care to protect from weather, and contamination from other substances as this will affect recyclability
  - grey: inert – clean concrete, rubble, hardcore, brick etc
  - black: mixed general waste (non-hazardous)
  - blue: mixed metal
  - green: wood, clean untreated (treated timbers may contain hazardous preservatives)
  - brown: packaging – paper and cupboard
  - orange: hazardous – wastes containing dangerous substances.



Figure 4.31 Colour coded skip

Other segregation, even if it falls under one of these broad categories, may be necessary depending on recycling/disposal route and receiving facilities requirements. There may also be specific requirements that apply to waste substances covered by other legislation and guidance, such as:

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- asbestos
- POPs waste
- electrical and electronic equipment
- stockpiles of different materials should be kept separately (**Figure 4.32**).

Segregation of the excavated arisings should be carried out by a competent person capable of identifying hazardous materials such as asbestos in soils, suspect/unexpected contamination, and different categories of waste.



Figure 4.32 Stockpiling of different earthwork materials (courtesy Soilfix)

Storing and treating waste

During construction, if waste material is to be stored on site before collection and treatment or treated on site (eg crushing or reusing), this should be stored appropriately to prevent uncontrolled emissions to air water or land. Also it should be:

- placed on a hard standing area away from drains and watercourses
- clearly marked (eg waste aware signs)
- enclosed/secured to prevent waste escaping (eg blown by wind or from unauthorised access)
- (where possible) segregated by type
- suitable to contain that waste type (ie to prevent escape, including liquids leaking).

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Hazardous waste must be stored in suitable containers and must not be mixed with non-hazardous waste, non-waste, or different categories of hazardous waste.

Storage is typically an exempt activity but there are time limits for storage of waste materials. Indefinite storage on land of waste could meet the legal definition of a landfill.

Some old stockpiles may be deemed by the relevant regulator to be a landfill and may prevent some types of authorisations being used for recovery and/or use of the stockpiled material.

Unless excluded waste under the WFD, all waste activities require authorisation, an environmental permit, licence, PPC permit exemption, or to be carried under a regulatory position (Berryman, 2023). These requirements should be identified before works start on site as some authorisations can take time to obtain.



Once the waste has been suitably treated on site in accordance with the waste permit, licence, or exemption it may have reached its EoW status. It may no longer be classed as a waste and can be used for its defined purpose on site as a product. Some treatments may result in suitability for use on the site but still be considered a waste and require use under other authorisation, for example small volumes of manufactured topsoil from waste being used on a commercial site in England under RPS 190.

4.5.3.9 Wastes requiring specialist services or consideration

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Asbestos

Asbestos is a hazardous material. In the past it was extensively used in various applications including:

- insulation of pipes and boilers
- fire protection in panels, wall partitions, ceiling panels and around structural steel work
- roof and wall cladding
- gutters, rainwater pipes and water tanks
- reinforced plastics and sealants
- bound in concrete.

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During renovation or demolition, the asbestos may be disturbed through drilling, cutting, or sanding. Such disturbance release potentially harmful fibres into the atmosphere that could be hazardous to health. It may be present in soils, made ground and recycled aggregates.

If asbestos is found or suspected, stop work immediately and contact a specialist contractor to remove it (see **Section 4.3**). Removal of asbestos is regulated by the HSE and requires a specialist licensed contractor to undertake the work; specialist licences for transport and disposal are required for asbestos waste.

All staff who may come into contact or work with asbestos, or who supervise staff who may encounter or work with asbestos should have received information, instruction and training as required by Regulation 10 of CAR 2012. See also CIRIA C765 (Studds and Bell, 2017).



Persistent organic pollutants

Wastes containing POPs such as PCBs have thresholds at which they are considered 'POPS waste' and must be destroyed. POPS waste cannot be reused.

Sharps

'Sharps' are needles, syringes and other objects that can cause potential harm if the skin is pierced. If these are found on site do not touch any items and call a specialist contractor to remove them. Removal of sharps must be carried out under a specific MS, which should be reviewed and approved by the contractor. A registered waste carrier is sufficient to transport sharps waste, with an appropriate PPC or waste management licence in place to allow disposal.

Waste electrical and electronic equipment

Directive 2012/19/EU (WEEE Directive) was brought in to reduce landfilling of electrical and electronic equipment (EEE) and improve design for dismantling and encourage recovery and recycling. All EEE should be collected separately and recycled at an approved authorised treatment facility (AATF) (**Figures 4.33 and 4.34**). The AATF will issue an evidence note so that it can be proved the WEEE was dealt with responsibly.

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Figure 4.33 Segregated skips (courtesy BAM Nuttall)



Figure 4.34 Dedicated hazardous waste storage area

4.5.3.10 Monitoring and reporting performance

Updating site records and SWMP

It is considered good practice to update the waste management records or SWMP each time waste is removed from site or at least monthly, with the waste transfer evidence/consignment note information. Following this procedure provides a useful check that the transfer notes are being completed correctly and ensures records are always up-to-date.

A thorough review of the waste management records or SWMP should be done monthly, to assess performance against the waste action plan and targets. The review should include calculating the costs of waste treatment and disposal.

The site manager should allocate responsibility to a nominated person to carry out waste audits/inspections at regular intervals to look at:

- quantities of each type of waste generated, reasons why and its cost implications
- how wastes are being handled and stored
- recommendations for improving waste management.

Conducting audits will provide valuable information to help set targets for improvement, show how well compliance is being achieved and which waste management initiatives from the action plan are working.

Material recovery facility monitoring

Where possible, it is good practice to ensure that exact recovery and recycling data from these facilities are obtained rather than using average statistics, which will not accurately reflect the sites performance.

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End of project assessment and reporting

At the completion of the project, it is good practice, and often a requirement for environmental assessment schemes, for the person responsible for waste management on site to undertake a full review of the plan and expected performance, including planned waste and reuse targets, against the actual performance achieved.

The review will provide valuable information, which can be used on future projects to define site waste management planning and assist in developing a SWMP. It will also give a benchmark to compare performance against.

4.5.3.11 Waste disposal

If possible, disposing of waste to landfill or incineration should be avoided. Most construction waste can be reused, recycled, or recovered if it is managed properly, and early planning should allow opportunities for alternative uses to be sought. When sending material to landfill is unavoidable then remember that:

- there is a duty to confirm that the Waste Hierarchy has been considered
- the waste is required to be described and classified
- the waste characterisation, including WAC, should be shared with the landfill operator to confirm they can accept the material
- all material being sent to landfill is required to undergo pre-treatment
- a registered carrier must be used to transport the waste
- waste duty of care documentation checks are required, for example:
  - check the public register for a landfill licence/permit and obtain copies of the permit/licence with conditions
  - check the waste carrier/haulier is on the public register
- each load leaving the site must have a completed CoC form (eg a HWCN/SWCN or WTN) and evidence needs to be kept to demonstrate the waste has reached its final destination (ie CoC form fully completed)
- records for HWCN/SWCN and WTN should be kept for three and two years respectively.

The Landfill Directive defines treatment as: *"the physical, thermal, chemical or biological processes, including sorting, that change the characteristics of waste in order to reduce its volume or hazardous nature, facilitate its handling or enhance recovery"*.



Note that simple physical dilution by mixing waste, without simultaneous chemical or physico-chemical changes, is not an acceptable treatment process and is prohibited by the Landfill Directive.

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Some substances are banned from landfills such as liquid wastes, tyres, and POPs waste (which must be destroyed).



Landfill Tax

Landfill Tax is charged when material is disposed of at landfill sites unless exempt (eg dredging, mineral waste). It is also due when a disposal is made at an unauthorised site.

Landfill tax is a devolved matter in Scotland (Scottish Landfill Tax, SLfT) and Wales (Landfill Disposal Tax, LDT).

In the UK there are two rates of tax (correct for 2023–2024):

- Standard rate: £102.10 per tonne
- Lower rate: £3.25 per tonne

In addition to these rates in Wales, on 'unauthorised disposals' made at places other than authorised landfill sites, the rate is set at £153.15 per tonne of waste (150% of the standard rate).

To qualify for the lower rate the materials must appear on the relevant jurisdictions qualifying material list, which can be found in The Landfill Tax (Qualifying Material) Order 2011 (England and Northern Ireland), the Landfill Disposals Tax (Wales) Act 2017, and The Scottish Landfill Tax (Qualifying Material) Order 2016.

4.5.4 Water

4.5.4.1 Why this is important

Water is essential to life. It is needed to grow food and for drinking, and for energy production and industrial processes etc. It is also needed in many construction processes and activities such as:

- site cabins, temporary accommodation (including drinking water) and other welfare facilities (eg toilets and showers)
- wet trades
- ground works
- dust suppression
- hydro-demolition
- cleaning

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- commissioning/testing of equipment/services
- concrete/mortar production
- plaster/grout mixing
- drilling and piling
- landscaping etc.

4.5.4.2 Water stress

In the UK, climate change means summers are becoming hotter and drier putting stress on water resources. In July 2021, the EA (2021f) published a final classification in England that shows most areas are *"under serious water stress"* (**Figure 4.35**). In 2022, the EA declared *"drought in eight of its 14 areas: Devon and Cornwall, Solent and South Downs, Kent and south London, Herts and north London, East Anglia, Thames, Lincolnshire and Northamptonshire, and the east Midlands"*. Similarly, SEPA (2022) issued warnings of water scarcity in October 2022.

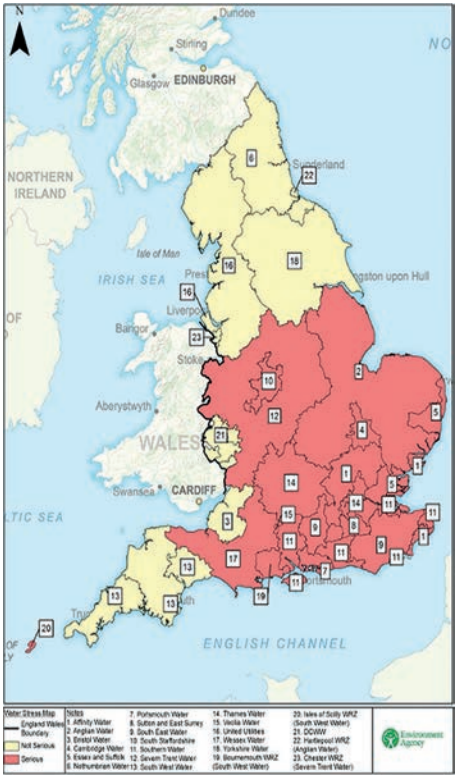


Figure 4.35 State of water stress in England as of 2021 (from EA, 2021f)

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Many construction companies are addressing the challenge of water resilience by reviewing their site practice.

A large construction and property services company is committed to achieve 50% reduction in water consumption on their sites by 2030 and have introduced the following measures:



- install water meters as soon as site work starts
- use early opportunity to install and connect environmental infrastructure on site for later applications, eg dust suppression and wheel wash
- maximise water efficiency by using aerated taps, flow control and waterless urinals
- display environmental performance figures in prominent places on site
- ensure site teams have considered what potable water is required and other options.

4.5.4.3 Flooding and escape of water

Flooding and escape of water because of other reasons, such as leaking pipes, can cause significant damages to construction sites. This has become more serious with extreme weather events such as the increasing frequency of intense rainfall. This may cause:

- additional work (and costs) on site – flooded excavations and other work areas require draining or de-watering
- more water pollution – water can mobilise and transport pollutants such as sediment, oils, chemicals, and other building materials into the water environment
- water damages can cause delay to the project and expensive repair fees.

4.5.4.4 Water pollution

Materials, chemicals, and waste matters (including silt, cement, concrete, oil, petroleum spirit, chemicals, solvents, and sewage) from construction activities can cause pollution to the surface and groundwater. These can (SEPA, 2009):

- cause harm to plants and animals and disrupt habitats
- make receiving waters unsuitable for potable or industrial abstraction, fish farming, angling, agricultural stock watering, and general amenity/tourism etc.

Table 4.5 details common water pollutants from construction sites and their environmental effects.

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Table 4.5 Common water pollutants and their effects on the aquatic environment

Common pollutants	Adverse effect on aquatic environment
Silt	Reduces water quality, clogs fish gills, covers aquatic plants, smother invertebrates, affecting food sources for macro-ecology
Bentonite (very fine silt)	Reduces water quality, clogs fish gills, covers aquatic plants
Lime	Raises pH of water and is harmful to fish and other wildlife
Cement or concrete wash water (highly alkaline)	Changes the chemical balance, and is toxic to fish and other wildlife
Detergent	Removes dissolved oxygen, can be toxic to fish and other wildlife
Hydrocarbons, eg oil and diesel	Suffocates aquatic life, damaging to other wildlife (eg birds) and water supplies including industrial abstractions
Sewage	Reduces water quality, is toxic to fish and other wildlife, and damages water supplies

A site does not need to be next to a river or other water body to cause pollution. Any pollutants getting into subsoil, surface water drains, dry or wet ditches/channels, or groundwater can end up in a river. Often these pollutants can be tracked back to their source.

Even very small amounts of material can be a pollutant. For example, five litres of oil can disperse to cover an area of water the size of four football fields.

A UK housebuilder was fined £120 000 for failing to control runoff resulting in the discharge of silt into a watercourse. This had a significant negative impact on the water quality up to three kilometres downstream of the site for several weeks (EA, 2017).



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4.5.4.5 Good practice checklists

Reduce water consumption	✓
Consider the Water Hierarchy when designing water management on site, which also includes estimating water use	
Consider installing water meters, aerated taps, flow control and waterless urinals and low-flush or high-efficiency toilets in site offices	
Consider installing measures that can detect water leaks	
Consider the use of alternative water sources, eg rainwater reservoirs, recover non sewage and greywater for on-site use, eg toilet flushing and landscape irrigation	

Building materials	✓
Consider using dry mortar and avoid using water to cure plaster, screeds and spray or pond concrete	

Reduce water consumption in vehicle, boots, and tool washing	✓
Avoid continuous water flow while cleaning	
Consider using lignin-based dust suppressors if appropriate. Although initial application contains water, the suppression of dust is more efficient and lasts longer	
If possible clean most adhering material mechanically first, then use wet rags	

Reduce water pollution	✓
Before the project starts	
Make sure there is a water pollution plan	
Make sure permits and/or consents and licenses (eg water abstraction, water discharge) are in place and conditions are met	

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Reduce water pollution	✓
Store all chemicals and hazardous substances away from water courses and drains in a contained and bunded area on an impermeable surface	
Identify potential water pollution pathways and receptors as well as define suitable control	
Identify temporary drainage patterns on site where cut-off channels and site drainage towards settlement features should be	
Check the annual rainfall data, soil types, site topography and flow paths during the various planned stages of construction	
Identify site drainage as surface, combined, or foul water and suitably colour coded and marked on the site plan	
Consider constructing pre-earthworks ditches to prevent clean water entering the site	

Managing runoff and silty water	✓
Do not discharge silty or discoloured water from the site	
Vehicle and wheel wash	
Install vehicle and wheel washing facilities including a high-pressure water jet at each site exit	
Site boundary	
Consider constructing a perimeter temporary drainage channel and catchpits along the site boundary to stop surface runoff flowing out of construction sites	
Seal the footing of hoarding to avoid seepage of surface runoff	
Maintain a filter (or buffer) strip to protect surface water (minimum of 10 m)	
Protecting soil/construction materials	
If possible, minimise the amount of exposed earth	
Consider erecting silt fences along the downslope or side slope of disturbed areas	
If straw bales, geotextiles or silt curtains are used, ensure they are securely fixed and maintained	

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Managing runoff and silty water	✓
Consider seeding, rolling, or covering stockpiles. Cover open stockpiles of construction materials or soil on site (> 50 m^3) with tarpaulin or similar fabric during rainstorms	
Stockpiles should be positioned away from watercourses and drainage and any potential contamination from dust or runoff controlled	
Consider covering visible slope/soil surface by tarpaulin to reduce the potential of soil erosion	
Contamination from processing of concrete	
The washout from a concrete mixing plant, or and from the cleaning of ready-mix concrete lorries, is contaminated with cement and so is highly alkaline. Do not allow it to enter any watercourse or groundwater. Alternatively consider returning the wagon to the batching plant to wash out the container, ie only the chute on site to minimise wash waters on site	
In or near a watercourse, control the placing of any wet concrete to minimise the risk of cement leaking into the watercourse. Shutter failure in such locations can cause major pollution in the watercourse	
Carry out regular checks on ready mix concrete wagons to check for defects, in particular hydraulic hoses, when works are being carried out in or near watercourses	
Do not discharge gully pot residues to surface water or groundwater. Identify alternative disposal options including discharge to the foul sewer (with the consent of the local sewerage provider) after solids settlement, or to a suitably licensed waste disposal site	
Drains	
Make sure site drainage is sized appropriately for rainfall and soil types	
Make sure the correct connections are being made with either foul sewers, surface water drains or combined systems	
Make sure silty or discoloured water is not discharged from the site	
Make sure surface water runoff is not directly enter waters or drains	
Designate an area within the site compound for routine plant maintenance. Plant maintenance area should be on hard-standing and remote from surface water drains	

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Managing runoff and silty water	✓
Keep water away from unsurfaced areas using measures, such as cut-off drains. Control and dispose of silty water in a controlled manner, all discharges other than clean rainwater, eg storm drainage and excavation dewatering wastewater, may require consent. Adequate treatment, eg settlement, should be provided before discharge	
Settlement tank	
Make sure if a settlement tank is used, water is not moving too fast and/or overflowing (other than at the discharge point)	
Dispose washout water to the foul sewer via a settling tank	
Make sure a consent is in place to dispose washout water and conditions are met	

Managing effluent from washout facilities	✓
Wash vehicles (including wheels), boots and tools in a suitably contained designated area that is impermeable and/or lined	
Make sure designated washout area is at least 10 m away from drains and waters	
Make sure surface water and groundwater are protected from washout	
Make sure there is a plan/procedure to dispose washout water	

Avoiding spills	✓
Debris and rubbish generated on site should be collected and disposed	
Oils and fuels should only be used and stored in designated areas that have pollution prevention facilities	
All fuel tanks and storage areas should be provided with locks and be sited on sealed areas, within bunds of a capacity equal to 110% of the storage capacity of the largest tank	

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Avoiding spills	✓
Store fuel, oil, and chemicals away from drains and water bodies, and in secondary containment in accordance with the appropriate pollution prevention regulations	
Store solvents, chemicals, or paints in accordance with their COSHH datasheets and appropriate oil storage regulations	
Consider using drip trays/plant nappies for equipment	
Transfer chemicals between containers only within a suitably bunded area	

Monitoring and inspection	✓
Storage, use, and delivery procedures for oil, fuels and other chemicals should be checked regularly	
Establish a regular monitoring procedure for water discharged from the site and keep records (turbidity/flow rate)	
Undertake regular inspection of watercourses on and near to a site to check for signs of pollution, eg discolouration in waters at or near the site	
Check outfalls and pipework daily to ensure they are clean and clear of litter	
Monitor bunds and machinery for leaks	
Monitor any water treatment methods to ensure their effectiveness	
Inspect scour protection, cut-off channels and settlement features	
All drainage facilities and erosion and sediment-controlled structures should be regularly inspected and maintained	
Monitor and investigate any complaints, incidents, and/or near-misses	

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Dealing with water in excavations	✓
Measures should be put in place to prevent water from entering excavations	
If appropriate, make sure that regulators (ie EA/SEPA/NRW/NIEA) are notified when undertaking excavation below the water table including any site dewatering	
Make sure discharge permit/licence/consent for the disposal of water from excavations is in place and conditions are met if required	
Consider installing cut-off ditches, walls or well point dewatering to manage water flowing into excavations	
Make sure water dewatering is disposed of appropriately (ie through a settlement tank, sewer, ground or offsite depending on water quality)	

Settlement tank/lagoon/ponds/wetlands	✓
The size of the tank/lagoon should be adequate for the settlement time required and the rate at which water flows or is pumped into it	
Consider installing a long, narrow, shallow settlement lagoon to ensure maximum retention time of all water in the lagoon	
Make sure permit/licence/consent to pump clean water from the surface of settlement lagoons into waters or a designated discharge point is in place and conditions are met	
Make sure the entry chamber is periodically to prevent a build-up of silt	
Make sure the outflow quality is regularly inspected/monitored	

Abstracting water	✓
Make sure the site has a licence/permit to abstract water and conditions are met	

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Discharging water	✓
Make sure that permits for disposal of water are in place and conditions are met	
Make sure site staff are aware of the quantity and quality of water that can be discharged	
Check for any visible sign or smell of pollution in waters at or near the site	
Make sure water is treated effectively before disposal	
If a settlement tank (or lagoon) is being used, check it is working properly	
Discharges should be monitor regularly and in accordance with any permit conditions	

Working over or near to water	✓
Make sure the relevant permits are in place and conditions are met	
Avoid storing fuel in containers near water	
Refuelling in designated areas should be as far away as possible from water courses and surface water drainage	
Check that the banks or bed of waters outside the area of the works are not being affected by discharges or vehicle movements	
Spray, dust, or other airborne materials should be prevented from entering waters	
Approaches to the watercourse should be kept free from the build-up of mud	
If using a cofferdam to retain water, it needs to be in good condition and working effectively	
Regularly check waters downstream of the works to see if these are silted or discoloured or if there is an oily sheen visible on the water	
Ensure spill kits are adequately stocked	
Make sure that site staff are aware of the location of spill kits and know how to use these properly	

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Working over or near to water	✓
Mitigation measures should be put in place in the event of an emergency (eg booms across river)	
Store all fuel oils and chemicals as far away as possible from a water course	
Test emergency procedures regularly	

Pontoons and barges	✓
All fuel tanks to be secure and safe on the vessel so that there is no chance of collision damage or accidental spillage overboard	
Contaminated bilge water should be pumped to suitable facilities ashore, or absorbents used	

4.5.4.6 Legal and regulatory requirements

Although the need to reduce water consumption has been the government's agenda for many years, UK regulations have focused more on buildings. For example, changes in Approved Document Part G of the Building Regulation 2010 (DLUHC and MHCLG, 2023) includes the requirement for tighter water efficiency. However, improving water efficiency is also important to construction sites.

The Water Resource Act 1991 states that UK waters, including rivers, streams, ditches, ponds, lakes/lochs/loughs, groundwater, and coastal waters (up to 3 nm offshore), have legal protection from harm and pollution. It is also an offence to cause or knowingly permit any polluting or solid waste matter to enter controlled waters without an authorised discharge consent. More recently, Part 5 of the Environment Act 2021 sets out measures to improve water resources planning and considers the needs of all sectors of water users, including construction industry.

Permits are also needed for water abstraction and working near a water course.

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4.5.4.7 Before site work begins

How to reduce water consumption

- Ensure that the water management plan follows the Water Hierarchy (**Figure 4.36**).
- Evaluate the potential challenge of minimising water use on site and water waste.
- Identify where and how water is used.
- Identify control and management methods to ensure water is used efficiently – use a water meter, water-saving devices such as aerated taps, waterless urinals and toilets in site offices and on site, and hoses with triggers.
- Develop an emergency response plan for leaks and spills.
- Consider harvest rainwater if appropriate.
- Ensure the relevant permits are in place.
- Ensure all site staff are aware of water saving practices and understand the water footprint of their work by receiving appropriate training.

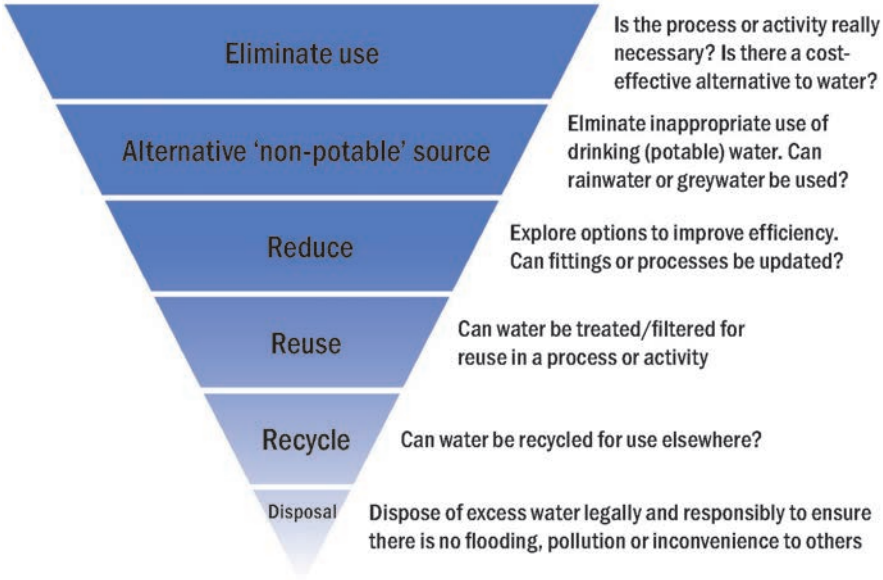


Figure 4.36 The water hierarchy (from Thornback et al, 2015)

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How to plan excess water including flooding

Managing the escape of water from construction sites should take a prominent place in the project's risk register. More information can be found in CIREG (2019).

Other tips include:

- Nominate a competent, responsible person, overseen by the principal contractor, for the management of the escape of water risk.
- Prepare a water management plan. This should include emergency plan/ procedures and where equipment, such as spill kits, wet vacs, temporary bunds, sump pumps, brushes etc, are stored on site.
- Switch off temporary water supplies outside working hours. A main valve should be readily accessible, and people designated to perform the task.
- Place temporary water pipes away from electrical risers and temporary electrical supplies.

Flooding due to natural causes

Understanding the risks of flooding at the early project stages is essential. This includes obtaining information specific to a site's degree of flood risks; what type of flooding is possible and frequency, and the predicted water levels and flows should be sought, also details of any watercourses close to the construction site etc. Site flood history can be obtained from flood maps and the regulators (see **Box 4.7**).

Precaution is also needed to ensure there is adequate drainage when necessary and water is not allowed to build up into large puddles, keeping walkways and exits clear and accessible. There should be emergency evacuation procedures in place so that workers and equipment can be protected or moved as quickly and easily as possible when there is a flood.

Other flood prevention measures include using ground protection mats to stop heavy machinery and vehicles from breaking up the ground surface. This will reduce the formation of mud that is washed into drains and block grates making flooding worse.

Where debris is inevitable, consider putting a bog mat over exposed drains on dry days to avoid them becoming blocked – remember to uncover the drain in wet weather.

For more information:
https://www.timbermat.co.uk/civil-engineering/prevent-floods-on-construction-sites/

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Box 4.7 Flood mapping

England

EA flood map: **https://flood-map-for-planning.service.gov.uk/**

What to do in a flood: **https://check-for-flooding.service.gov.uk/what-to-do-in-a-flood#:~:text=If%20you%20haven't%20already,for%20the%20latest%20flood%20updates**

Wales

NRW flood map: **https://naturalresources.wales/flooding/check-your-flood-risk-on-a-map-flood-risk-assessment-wales-map/?lang=en**

Welsh Government Flood warnings and help: **https://www.gov.wales/flood-warnings-and-help#:~:text=1.-,During%20a%20flood,warnings%20on%20Natural%20Resources%20Wales**

Scotland

SEPA flood map: **https://www.sepa.org.uk/environment/water/flooding/flood-maps/**

Flood Line Scotland:
https://www.floodlinescotland.org.uk/media/9009/270718floodingleafletwhattodowhocanhelp.pdf

Northern Ireland

Department of Infrastructure flood map:
https://www.infrastructure-ni.gov.uk/topics/rivers-and-flooding/flood-maps-ni

Reporting flooding: **https://www.nidirect.gov.uk/articles/reporting-flooding**

UK-wide

Met Office: https://www.metoffice.gov.uk/services/business-industry/construction

How to prevent water pollution

1 **Develop water pollution control plan.** Pay particular attention to sources of diffuse pollution.
   - a carry out surveys to identify the location of all watercourses, lochs, wetlands, and drainage paths for surface water, protected habitats, and species
   - b establish buffer zones around watercourses and protected habitats/species and consider buffer strips and working/storage distances from watercourses
   - c assess potential flood risks – this will include reviewing flood maps
   - d identify potential sources of pollution
   - e determine timing of works and avoid, if possible, fish spawning, fish migration times, and bird nesting seasons
   - f provide training for all site staff
   - g develop emergency procedures
   - h determine monitoring requirements.

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Diffuse pollution is the release of (potential) pollutants from a range of activities that individually may have no effect on the water environment, but at the scale of a catchment can have a significant impact (ie on water quality and wildlife). So, while an individual instance of silt pollution from a site may not have an effect, many instances across the site into the same water catchment could be significant.

Consider watercourses and drainage paths away from high-risk locations, including:



- fuel and chemical storage
- refuelling areas
- material stockpiles
- vehicle and equipment washing areas
- site compounds/parking areas.

2 **Surface water runoff may cause significant pollution problems.** To resolve this, the following should be considered:

a Can the work plan be altered to minimise land clearing and land shaping (ie phased stripping)?

b Can the work plan be altered to allow permanent stabilisation of disturbed areas as soon as land shaping is complete?

c Can undisturbed areas be used as sediment buffer zones either during construction or long term as appropriate?

d Can site entry points be located to minimise soil contamination of vehicles, and is it possible to allow the early establishment of all-weather parking areas?

e Is it possible to carry out early or phased landscaping to minimise the length of time soils/ground is exposed, which may cause water pollution?

f Can the works be sequenced to make best use of existing buffer zones and stabilised areas?

g Can the development be staged so that most of the ground disturbance occurs outside periods of water saturation?

h Will the site experience heavy rainfall?

i What is the soil type on site? Clay soils are much more difficult to remove from site runoff once mobilised than sandy soils.

If runoff is likely to occur, surface water needs to be managed to minimise the amount running into excavation or disturbed ground. To achieve this, the following actions should be considered:

a ensure water storage is sufficient

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b ensure hard standing areas and surface roads are clean

c reduce overland flow, eg use lined (scour protected) cut-off channels to collect and channel water, and use check dams within them

d maintain vegetative buffer zones (minimum 10 m from waterways)

e use clean aggregate for haul roads

f distance of stockpiles from waterways (minimum 10 m)

g vegetate stockpiles or cover with geotextiles

h keep stockpiles on slopes that are not subject to failure and consider gradient and height accordingly

i use silt fence (see **Box 4.8**).

Box 4.8 Silt fencing

When using silt fencing (**Figure 4.37**), consider the following:

- It should not be used to remove sediment from concentrated flows, such as pipe discharges or in flow watercourses.
- It should have adequate scour protection (eg rock mattresses, geofabrics) at points of concentrated discharge.
- It can stop erosion and silt laden runoff entering the watercourse.
- It should be shaped and installed so that it will catch runoff, without the water flowing underneath or around the edge.
- It is important that the bottom of the geotextile is dug into the ground so that water does not flow under the barrier.
- Grips, sumps, straw bales, and sediment traps can be installed to capture silt. Each of these should be regularly maintained (ie do not become blocked).



Figure 4.37 A typical silt fence (courtesy Galliford Try)

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3 **Drainage.** The drainage plan should identify all drains, the direction of the drain and locations of any nearby watercourses. Other measures needed include:

a manhole covers and drains should be colour coded, for example red for the sewer and blue for surface water. This can prevent accidental contamination of the surface water drain

b contaminated water should be drained into the foul water drain connected to a foul sewer (note that permission will be needed from the water company)

c clean water should be drained into surface water or soakaway.

Depending on the types of drains, their location and potential sources of pollution, control measures such as placing interceptors should be established to catch oils or place bunding or silt traps around drains to prevent silt runoff. See Defra and EA (2022).

4 **Effluent from vehicles, boots and tools washing.** For vehicles (including wheel) washing (see **Figure 4.38a**), provide a designated bunded area without drains and with measures allocated to recycle/treat the water for cleaning; beware of regulatory waste control (see **Section 4.5.3**). Contaminated wash water should be:

a discharged to the foul sewer (with the consent of the sewerage provider)

b collected in a sealed tank for removal off site by a licensed waste disposal contractor

If the site is not contaminated, and if water recycling/wheel washing systems are available, only the collected silt needs to be removed. If contaminated, the effluent should be collected in a sealed tanker.

Where possible, use non-hazardous and non-solvent cleaning products, and do not use detergents that affect the function of oil interceptors.

Wheel washing bays should be provided at every site exit if practicable and wash water should have sand and silt settled out or removed before discharging into storm drains (**Figure 4.38b**).

The section of construction road between the wheel washing bay and the public road should be paved with backfill to reduce vehicle tracking of soil and to prevent site runoff from entering public road drains.

For boot (**Figure 4.38c**) and tool washing (**Figure 4.38d**):

a Facilities should be provided for site staff to wash their boots. If the site is contaminated, water should be captured and treated.

b If tools and equipment need to be washed, ensure that this is undertaken away from any waters or surface water drains, on a designated collection area, to avoid infiltration of potential pollutants into soils.

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a Vehicle washer





b Wheel washing bays





c Boot washing

d Tool washing

Figure 4.38 Designated areas for washing

Do not allow water containing detergents to enter either surface water drains or other surface water or groundwater bodies. An environmental permit is needed to discharge effluent from vehicle wash to surface water. See EA and Defra (2022).

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4 **Concrete washout.** Concrete washout is a concern due to the highly alkaline nature of the wastewater and contained fines, which can cause harm if discharged directly into surface or groundwater. The Considerate Constructors Scheme best practice hub provides guidance on using a concrete washout unit (CCS, 2019).

If a settlement tank or silt press is used to treat water that contains concrete and silt (eg from washing equipment or damping down haul roads) an environmental permit is not needed (EA, 2020).

SEPA (2021) has reinforced the hierarchy of treatment and disposal of concrete washout water operations in Scotland. Similar requirements are in place in England and Wales regulated under The Environment Permitting (England and Wales) Regulations 2016 in addition to EA (2020) guidance.

For these sites, regulatory minimum requirements include:

a **Isolate.** Concrete washout or batching areas should not drain to any watercourses or drainage channels (**Figure 4.39**).

b **Collect.** Washdown water from the washing of equipment that has come into contact with concrete must be collected in an impervious (lined) container.

c **Treat** the collected liquid to enable recycling/reuse within the concrete washdown area or concrete batching process.

d **Dispose**. Wash water can be sent off-site to a licensed facility for treatment and/or disposal, in accordance with the waste duty of care.

Note that in Scotland washout water cannot be used for wheel washers or dust suppression purposes, while in England and Wales treated washout water may be used for washing equipment in accordance with EA (2020) (BAM Nuttall, 2022).



Figure 4.39 Lined washout pit

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6 **Spillages.** To avoid spillages, take the following precautionary measures:

a carry out activities involving potential pollutants, such as concrete or fuel, in dedicated areas that are designed to capture and dispose of spills, leaks, and drips (see Defra and EA, 2022)

b use secondary containment such as bunds around oil storage tanks, double-skinned fuel bowsers, and drum pallets (for inside/under cover use)

c use drip trays/plant nappies under mobile plant (see **Figure 4.40**)

d supervise all deliveries and refuelling activities

e designate a refuelling area on an impermeable base, away from surface water and vehicle movements and ensure there is appropriate signage

f provide secure containment for fuel oil and chemicals, appropriately bunded, and consider signing in and out procedures

g provide and identify trained site staff to supervise and carry out refuelling training.



Figure 4.40 Drips trays

See also **Chapter 3**.

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Forward or risk planning can ensure a speedy emergency response. Provide adequate supply of appropriate spill materials such as granules, pads, socks, and booms. Training in spill procedures should be given to site-based staff – all site staff should be aware of the appropriate action in the event of an emergency.



Develop a spill response plan or procedure for the site.

Report any environmental damage to surface water or groundwater, and notify any spillages to the regulator:

England: **www.gov.uk/report-an-environmental-incident**

Wales: **https://naturalresources.wales/about-us/contact-us/report-an-environmental-incident/?lang=en**

Scotland: **https://www.mygov.scot/report-environmental-incident**

Northern Ireland: **https://www.nidirect.gov.uk/articles/report-polluted-land-and-water**

DIVERT clean water away from exposed soils and working areas.

MINIMISE erosion of exposed soils.

PREVENT contaminated water from entering watercourses untreated.



Water abstraction and discharge

Abstraction is taking water from a surface or underground source. Some construction activities, for example temporary works, concrete batching or dust suppression, require water to be abstracted from surface water or groundwater.

A licence is needed (unless it is an exempt activity) to abstract water because it is a resource. Over abstraction, or impeding flows, can lead to:



- shortages in water supply
- increased pollution due to the reduced dilution of pollutants
- damage to habitats
- changes to the water regime (eg groundwater drawdown) or reduction of levels in water bodies (eg ponds).

For more information see EA (2022c), and also:

- Water abstraction licence (Scotland): **https://www.gov.uk/water-abstraction-licence-scotland#:~:text=You%20may%20need%20to%20get,watercourses%20or%20underground%20water%20reserves**
- SEPA Water abstractions: **https://www.sepa.org.uk/regulations/water/abstractions/**
- NI Water abstractions: **https://www.netregs.org.uk/environmental-topics/permits-licences-and-exemptions/permits-and-licences-an-overview/water-abstraction-and-impoundment-authorisations/#:~:text=Check%20if%20you%20need%20an%20abstraction%20licence&text=If%20you%20abstract%20more%20than,minimise%20water**

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Discharges should only be made to drains if there is a licence or consent/permit from the environmental regulator. For example:

- Foul water sewer – effluent discharge consent is required from the sewerage provider.
- Waters from surface water drains or any other temporary/permanent outfalls installed to serve the site – discharge consent/permit from the relevant environmental regulator.
- Discharge to land with the landowner's permission and, possibly, the environmental regulator.
- If the discharge of water is necessary, discharge to foul sewer should be considered in preference to surface water drains.

Water used on site may be contaminated with pollutants that cannot be discharged to the sewer. In these circumstances it will have to be pumped into a tanker or intermediate bulk container for disposal to an appropriately licensed disposal facility.

The disposal route and the relevant permits needed for different types of effluent should be determined and secured before the work starts on site.

In England and Wales, if the runoff is not 'clean and uncontaminated' permission should be in place for discharging effluent or wastewater to surface water, eg rivers, lakes, estuaries, and into/onto ground. Wastewater includes water with poisonous, noxious, polluting and waste substances, trade, or sewage effluent (see SEPA, n.d.).

In Northern Ireland, other than uncontaminated water, discharge consent is needed for discharge to surface water and a groundwater authorisation for discharge to groundwater.

In Scotland, there are three levels of authorisation under CAR 2012, ie general binding rules, registration, and water use licence.

Further guidance is provided by NetRegs: **https://www.netregs.org.uk/NetRegs**

Working over or near to water

To avoid risk of water pollution:

- ensure that comprehensive risk assessments have been undertaken
- where relevant, use floating platforms such as decks and barges below the works (acting as a bund in case of spillage)
- identify measures to prevent water entering a watercourse (eg sandbags, silt fencing)
- check the availability of primary and secondary booms to contain pollutants in the event of substances entering the water

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- consider erecting dust screens on bridges
- consider surface water, groundwater, and flood water flows and pathways
- refuelling should be undertaken as far away as possible from water courses, on impermeable ground, and supervised.

In England, permission is needed from the EA for activities that:



- erect, repair or alter temporary or permanent structures in, over, or under a main river, eg a culvert, outfall, and scaffolding
- dredge, raise or remove material from a main river
- involve quarrying or excavating within 16 m of any main river, flood defence or culvert
- divert, impound the flow of water, or change the level of water in a main river
- within 8 m of any flood defence structure or culvert on the main river, or 16 m of any tidal river
- within 8 m of the bank of main rivers or 16 m of any tidal main river.

In England and Wales, flood risk activity permits are required (previously called flood defence consent) for work:

- on or near a main river, a flood defence structure, or a sea defence
- in a flood plain

In Scotland and Northern Ireland, SEPA and NIEA need to be notified in advance of similar works and, depending on the scale of the activity, a licence may be required.

Further information on permissions can be found via the relevant regulatory or government body, see EA and Defra (2022b), NRW (2022b), SEPA (2023), DAERA (2023) and DfI (2023).

4.5.4.8 During construction

How to reduce water consumption

- Monitor site cabins/temporary accommodation using meter readings and inspect leaks and waste.
- Inspect site regularly, including checking for water leaks.
- Ensure water supply can be switched off at point of use, for example a trigger gun attached to a hose (see also **Section 4.4.1**).
- Concreting – use water from settled concrete washout area to clean equipment.
- Groundworks – use auto shut-off taps (eg trigger type hoses/taps) for grouting.
- Dust suppression:
  - use water spraying bowsers (using water diffusers to create mist as more effective at capturing dust)

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- use temporary settlement lagoons if possible
- closed-loop water recycling for drive through wheel washes.

- Cleaning:
  - use buckets for small tools and small equipment for lorries, and recover water if appropriate
  - use ready mixed concrete wagons and washout pits with recirculation systems to reuse water in concrete mixes.

See Waylen *et al* (2011).

How to manage excess water including flooding

Following a flood, or other excess water event, it is important to:

- use sandbags to prevent the flood water entering buildings (eg offices)
- move equipment, vehicles, and chemicals that can cause pollution, to a safe and dry area
- turn off the electrical supply to the site.

All incidents of escape of water should be fully investigated and documented so that remedial measures can be put in place to prevent a reoccurrence.



How to prevent water pollution

1 **Monitoring**. Regular visual checks should be undertaken to look for:

a changes in water colour

b changes in water transparency

c oil sheen to the surface of the water

d scum or foam build-up on the surface

e signs of dead plants or animals

f the condition of control measures such as silt fencing.

Monitoring will have to be conducted if conditions are specified in trade effluent consents or discharge permits. This may include monitoring specified limits for flow rate, suspended solids, chemical or biological oxygen demand, or chemical constituents.

2 **Management of wastewater from construction sites.** Wastewater from construction sites can cause water pollution and this depends on:

a the quantities of water involved

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b the level of contamination in the water

c whether areas are available for storage and treatment

d sensitivity, quality, and flow of the receiving watercourse (should not be relying on dilution)

e the characteristics of the sediment

f groundwater table level

g slope gradient

h underlying geology (eg clay).

When managing waste water consider:

a areas available for storage and treatment

b level of any charges to be levied by the sewerage undertaker

c other users of the receiving water

d whether permission/consent have been obtained

To ensure the appropriate wastewater treatment option is selected, the following information and data are needed:

a size of the construction site

b annual rainfall data

c soil types

d site topography

e surface water flow paths during the various stages of construction

f sensitivity of receptors in or around the waters and the site.

Depending on the nature of the wastewater, specialist advice may be required to select the appropriate treatment and disposal route. This could include settlement tanks, lagoons, ponds, flocculation, disposal to sewers, or tanking off site etc.

3 **Temporary works – haul routes, access roads, and parking**. These are often formed by stripping topsoil and grading the subsoil to suit but will erode during heavy rainfall. The tracking of plant and machinery across wet or saturated soil can loosen and mobilise additional sediment. So:

a shed water from roads onto nearby vegetation, or construct ditches along the road edge(s) to prevent uncontaminated runoff flowing onto the road and to direct contaminated runoff to treatment facilities

b do not allow roadside ditches to discharge directly to rivers, burns, lochs, or wetlands

c prevent excess water running along the road by installing small earth bunds (ie speed bumps) or cut-off ditches at regular spacing to direct water into roadside ditches.

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https://www.carbontrust.com/resources/office-energy-efficiency-guides

CIRIA Soil Community portal: **www.ciria.org/SOILCOP/**

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www.ciria.org

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NETREGS *Consents and authorisations you will need*: **https://www.netregs.org.uk/environmental-topics/water/preventing-water-pollution/consents-and-authorisations-you-will-need/**

NETREGS *Environmental topics: persistent organic pollutants*: **https://www.netregs.org.uk/environmental-topics/materials-fuels-and-equipment/more-hazardous-materials-topics/persistent-organic-pollutants/**

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RESOURCE EFFICIENT SCOTLAND *Construction material exchange:* **http://cme.resourceefficientscotland.com/**

SUPPLY CHAIN SCHOOL *Waste and Resource Use Group*: **https://www.supplychainschool.co.uk/partners/groups/waste-group/**

The Control of Asbestos Regulations 2012 (No.632)

WATER FOOTPRINT NETWORK *WFA tools*: **https://www.waterfootprint.org/resources/interactive-tools/**

WATERWISE UK *Water strategy*: **www.waterwise.org.uk**

ZERO WASTE SCOTLAND (2021) *Construction resources for a circular economy*, Zero Waste Scotland, Stirling, Scotland **https://zerowastescotland.org.uk/sites/default/files/Construction%20Circular%20Economy%20Resources%200920.pdf**

ZERO WASTE SCOTLAND:

Construction resource library: **https://zerowastescotland.org.uk/content/construction-resource-library**

Create a site waste management plan: **https://zerowastescotland.org.uk/construction/waste-management-plan**

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4.6 TRAFFIC, TRAVEL MANAGEMENT AND VEHICLE USE

4.6.1 Why are these important

Traffic on and around the site can:

- cause nuisance through noise, exhaust emissions, dust, air pollution congestion, and mud. These can also cause ill health to site workers and people who live near the site
- be a hazard to construction workers, and create a risk of damaging materials and causing pollution incidents (eg vehicles damaging oil containers leading to ground pollution)
- increase carbon emissions. On-site traffic management is also important to whole life carbon and upfront carbon calculation (Scottish Futures Trust, 2021).

On average, about seven workers die every year because of accidents involving vehicles or mobile plant on construction sites, and a further 93 are seriously injured. See HSE (n.d.3)

4.6.2 Good practice checklists

Traffic management plan	✓
Consider using innovative approaches, eg on-board software to increases HGV fuel efficiency, route planning, adaptive cruise control, and telematics devices on freight vehicles can provide a significant volume of data to support better fuel efficiency	
Identify sensitive areas, for example educational facilities (ie schools and universities) and homes	
If possible on-site routes should include one-way systems and turning circles	
Make sure speed limits are in place	
Be aware of road restrictions, for example road works, narrow roads, and bridges with height and/or weight restrictions	
Choose suitable materials for use on access roads to avoid transferring mud and dust	

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Traffic management plan	✓
Take into account the traffic needs of nearby developments that could affect a construction site	
Identify suitable locations for parking facilities for cars and plant	
Make sure there are designated walkways on and around site	
Make sure there are designated vehicle routes on site with speed restrictions	
Identify site entrance and exit and, if possible, do not locate off minor roads	
Make sure permission for road closures have been secured. The highways division of a local authority in smaller scale projects, or the Highways Agency for larger projects	
Develop a map showing delivery drivers' routes to site from trunk roads	
Schedule site deliveries outside times of peak traffic volume	
Make sure designated workers are on site to receive deliveries, direct vehicles on and off site, and act as banksmen	
Project vehicles should have badges on their windscreens displaying contact details for the project if they are found to be parked inappropriately	
If possible, offer alternative modes of transport for workers to get to the site such as minibuses, car sharing, or bicycles	
Consider alternative delivery streams, for example canals and railways, if feasible	
Monitor vehicle movements to reduce the likelihood of queuing or causing congestion in and around the local area	
Minimise the need for reversing vehicles (eg one-way systems) and potential nuisance issues from reversing alarms	

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Parking	✓
Designate an area on site for site-based staff parking	
Prevent delivery vehicles from queuing outside the site boundary	
Make sure delivery drivers are aware of traffic restrictions on and around the site	

Plant and vehicles	✓
Provide training to truck drivers so that they can reduce fuel consumption by good driving practice	
If possible, use a wheel wash for vehicles leaving the site to prevent mud being spread on surrounding roads	
Prohibit vehicle washing outside of any designated area on site	
If possible, use mechanical road sweepers and surface flushing apparatus to clean hard standing and remove any mud or debris deposited by site vehicles on roads, footpaths, gullies or drains near to the site	
Make sure exhausts do not discharge directly at the ground	
Consider using retractable sheeted covers to protect wind-blown material	
Make sure all plant and vehicles are in good working order	
Minimise loading and drop heights	
Reverse sirens – consider lorries with 'white noise/broad band' reversing alarms to minimise the effects of noise on residents	
If possible, use hybrid, electrical, or fuel efficient plants and vehicles	
Should emergency maintenance need to be carried out on site, ensure it is in a designated area away from sensitive receptors and that a spill kit is close to hand	

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Delivery schedule	✓
All deliveries to site should keep to their allocated time slot, failure to do so could mean they are turned away	
Do not accept deliveries on site without contractor staff to unload them or direct the vehicle	
Materials or rubbish should not be left in the unloading area	
Washout should occur only in designated areas	
All vehicle delivery drivers should wear PPE once inside the delivery area	
Ensure contractors are aware that incorrectly loaded vehicles will not be offloaded	

Site rules for drivers	✓
If possible, use electric or hybrid vehicles	
Access only via the main entrance gates	
On leaving the site, vehicles are to follow the directions previously given	
All engines to be switched off while waiting to unload	
No parking in residential streets surrounding the site	
All drivers should be asked to proceed with caution particularly at peak school times if the site is near to a school	
Drivers should adhere to the site speed limit	
All vehicles entering the site should stop and report to the gateman who will direct them to the required place of loading/unloading	
Avoid reversing on site unless a competent banksman is present	
Drivers should park in the designated area and wear appropriate PPE (eg safety helmet, boots and hi-vis jackets) while away from their vehicles	
All loaded vehicles leaving the site should be sheeted – this should be done using a mechanism before entering the wheel wash	

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Site rules for drivers	✓
All vehicles should pass through the wheel wash facility and be inspected by the gateman to ensure they are clean before the leaving site	
All loaded vehicles leaving the site should take the correct documentation with them. Ensure relevant copies of documentation, together with a copy of the weighbridge ticket, are handed to the gateman on return to the site	

4.6.3 Legal and regulatory requirements

Construction traffic can generate dust and noise, which are regulated by the appropriate legislation (see **Sections 4.4.1 and 4.4.3**). Providing a construction traffic management plan (TMP) is often a requirement of planning permission and will ensure vehicles and workers move around safely on site. It will also meet requirements from HSE (n.d.3).

4.6.4 Develop a good traffic management plan (TMP)

This should cover all forms of transport, for example road vehicles, pedestrians, bicycles.

A TMP should enable operatives to manage all these risks efficiently and effectively. It should be clearly written and presented, and well communicated to all site-based staff, subcontractors, suppliers, and site visitors. It is good practice to regularly review the TMP and to make sure that changes to the plan are appropriately communicated.

The TMP should include both off-site (ie travel to/from site, deliveries) and on-site (ie plant/car movements) traffic management requirements.

The use of public roads for site access may be restricted because of:

- weight and width controls
- parking controls
- low headroom access routes
- accessibility.

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Local authorities and the police should be consulted when preparing TMP. It may even be a planning or legal requirement or form part of an agreement with a local authority. This will help to identify both important times to avoid deliveries (eg during school runs) and appropriate delivery routes.



4.6.5 On-site traffic

Nuisance, potential impacts to materials, and polluting substances can be reduced by:

- having on-site roads as one-way systems and turning circles
- controlling access to and from the site
- adopting and enforcing speed limits
- ensuring delivery and waste removal vehicles are sheeted to prevent dust or material being blown into the air
- minimising drop heights when tipping materials or loading vehicles
- pointing exhausts upwards to disperse pollution and avoid blowing dust up
- communicating to drivers the need to comply with site rules and to maintain vehicles, and the consequences if these requirements are not applied; provide training for drivers if necessary.

The Met Office's Rainfall and Evapo-transpiration Calculation System (MORECS) calculates soil moisture conditions and can aid assessments of trafficability on site by providing assessments of rainfall, evaporation, and soil moisture.

See Met Office (2022).



4.6.6 Off-site traffic

Plan the timing of deliveries to avoid vehicles waiting and minimise engine idling.

Where several deliveries are likely to take place over a short period, designate queuing areas away from sensitive receptor areas, in liaison with the local authority if on public roads (**Figure 4.41**).

In urban areas it may be best to allocate a waiting area away from the site and then allow entry for deliveries when access is clear.

- Where possible, arrange site access so that all vehicles enter and exit in a forward direction.

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- A good materials management plan can help reduce the number of deliveries needed and make sure that they arrive at the right time of day. Details of site access routes and delivery times can be included with orders placed with suppliers on a clear map and with written instructions (see **Section 4.5.2**).

Encouraging site staff to car share or use public transport, and/or providing communal transport (ie minibus) can further reduce traffic to and from site and, if possible, using hybrid or electric vehicles.



Figure 4.41 Signage for vehicle routes

4.6.7 Site worker traffic

Site-based staff should not be permitted to park vehicles around the site boundary as this will cause a nuisance to residents and disruption to deliveries. Arrange designated parking areas when there is appropriate space to do so on larger projects. On confined sites this may not be possible, so workers should be encouraged to vehicle share, or arrangements should be made for a minibus to collect them from local train or bus stations.

Ensure facilities, such as secure areas to store bikes during the working day and showers, are made available.

4.6.8 Encourage good driving and loading practices

This includes:

- use a high gear for most of the trip distance
- use cruise control where possible
- minimise the amount of time spent idling

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- minimise the number of sudden decelerations (ie hard braking) and accelerations
- ensure tyres have good tyre pressure
- use progressive shifting
- limit the use of vehicle accessories
- ensure even load distribution between drive and trailer tyres.

4.6.9 Managing nuisance and congestion around site

Mud and debris from roads should be cleared regularly and it may be appropriate to install vehicle (including wheel) washing facilities (see also **Sections 4.4.1 and 4.5.4**).

Further reading

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A1 Example content of an EMP

1 Introduction
2 Purpose and structure
3 Scope of work, eg location, description of the works, construction programme, equipment, and plant
4 Environmental management framework
5 Environmental policy
6 Environmental aspects and impacts:
   a access routes/points
   b site housekeeping
   c water quality, flood risk and drainage
   d Carbon reduction
   e nature conservation
   f compensation and enhancement
   g landscape design
   h noise and vibration
   i air quality
   j archaeology and cultural heritage
   k soils
   l land contamination
   m waste
   n energy
   o materials
   p transport
   q pollution prevention
   r fuel and oil handling
   s maintenance of plant
   t concrete washout
   u control of sedimentation

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7 Legal and other requirements:
   a identification of applicable legislation and other requirements, consents and licences
8 Objectives and targets
9 Structure and responsibilities
10 Training awareness and competence
11 Communication (internal and external)
12 Operational control procedures
   a site establishment
   b boundary fencing
   c protection of environmental features
   d emergency planning
13 Complaints, compliments, and inquiries
14 Checking
15 Evaluation of compliance
16 Non-conformance and corrective/preventative action
17 Control of records
18 Management review

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A2 Examples of environmental assessment schemes

Considerate Constructors Scheme (CCS)

CCS is an assessment scheme designed to improve the performance of a construction project. Sites are assessed on a variety of criteria including health and safety, environmental management as well as community interaction.

www.ccscheme.org.uk

BREEAM Infrastructure (formerly CEEQUAL)

A sustainability scheme to improve design, construction and maintenance of infrastructure assets. The scheme encourages project or contract teams to consider sustainability issues as they develop, design and construct their work.

https://bregroup.com/products/ceequal/

BREEAM

A certified standard to improve sustainability performance of the built environment in the design, construction, operation and refurbishment stages.

https://bregroup.com/products/breeam/

Home Quality Mark

This is a badge that housebuilders may use to demonstrate that their homes have been constructed to a high standard.

https://www.homequalitymark.com/professionals/standard/

LEED

A green building certification system from the USA, for buildings or communities. The key assessment metrics are:

- energy savings
- water efficiency
- CO_2 emissions reduction
- improved indoor environmental quality
- stewardship of resources and sensitivity to their impacts.

www.usgbc.org/leed

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Defence Realm Environmental Assessment Methodology (DREAM)

DREAM is an online environmental assessment tool for new building and refurbishment projects on defence estates.

www.dreamassess.com

Constructing Excellence environmental performance indicators

Constructing Excellence produces a series of environmental indicators that aim to improve the industry. These can be applied to either benchmark a site's performance against industry standards, or to set targets for improvement.

https://constructingexcellence.org.uk/

BES 6001

BES 6001 is a standard for the responsible sourcing of construction products. It provides a way for organisations, manufacturing sites, or products to gain certification via a recognised auditing body. It is based on a points rating system.

www.bsigroup.com/en-GB/bes-6001-responsible-sourcing-of-construction-products/

Global Reporting Initiative (GRI)

The scheme is a disclosure framework for sustainable information and reports on a company's environmental, economic, and social performance depending on the size, sector, and location.

www.globalreporting.org

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LawWales: **https://law.gov.wales/**

Legislation: **https://www.legislation.gov.uk/**

Natural Resources Wales: **https://naturalresourceswales.gov.uk/?lang=en**

Northern Ireland Environment Agency: **https://www.daera-ni.gov.uk/northern-ireland-environment-agency**

NetRegs: **https://www.netregs.org.uk/**

Office for Environmental Protection: **https://www.theoep.org.uk/office-environmental-protection**

Scottish Environment Protection Agency: **https://www.sepa.org.uk/environment/**

The Alliance of Sustainable Building Products: **www.asbp.org.uk**

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Glossary

Abatement notices	A local authority has a duty under legislation to serve an abatement notice where it is satisfied that a statutory nuisance exists. The powers of an abatement notice include being able to stop work on the project.
Abstraction	The removal of water from groundwater or surface waters, either temporarily or permanently. Abstraction permits/licences are required from the local regional environmental regulator.
Archaeological remains	Antiquities, fossils, coins, articles of value, precious minerals, cultural artefacts.
Asbestos	A mineral that was used in many buildings as insulation material and fire retardant, in floor and ceiling tiles, and gaskets etc. Its use was banned in the UK due to severe health implications associated with exposure. However, it can still be found in many existing buildings and construction, and demolition waste and soil.
Attendances	Facilities and services provided by the main contractor to support sub-contracted elements of historic building/archaeological works. Chapter 8 of CIRIA C799 (Nixon *et al*, 2021) provides further detail of attendances to facilitate archaeological site investigation during construction.
Building Information Modelling	A collaborative way of working supported by a 3D computer model that can be used for management of information throughout a project lifecycle (HM Government, 2012).
Biodiversity	The variety of all life on earth.
Biodiversity Net Gain	An approach to development, and/or land management, which aims to leave the natural environment in a measurably better state than it was before (PAS, 2023).
Blue space	Outdoor environments, either natural or artificial, which contain water features (EA, 2021a).
Brownfield site	As opposed to a 'greenfield' site, a brownfield site is a generic term for land used previously for domestic,

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industrial, or commercial purposes, being available for redevelopment. Some brownfield sites are affected by contamination.

Chain of Custody

Documentary evidence that tracks the movement of samples, materials, and products etc from their point origin to their final destination. For example, the material used in a final product has been sourced from a certified sustainable supplier, or the water sample arriving at the test laboratory is the same sample as collected at site. This demonstrates traceability throughout the supply/transport chain.

Circular economy

A concept of production and consumption, which involves keeping resources in use as long as possible by reusing, repairing, refurbishing, and recycling existing materials and products (EU, 2023).

Climate change

The consequences of the naturally occurring greenhouse effect arising out of man's industrial and domestic practices leading to long-term changes in temperature and weather patterns.

Discharge permit to water and abstractions

In England and Wales any intended discharge to 'controlled waters' will require permission from the environmental regulator over granting of an environmental permit. In Scotland, any intended discharge to the water environment will require permission from the Scottish Environment Protection Agency (SEPA) for a Controlled Activity Regulation (CAR) point discharge licence under The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (see **Section 4.5.4**). In Northern Ireland, discharge consent is needed for all discharges to waterways and water contained in underground strata (under the Water (Northern Ireland) Order 1999).

Controlled waters/ water environment

This refers to almost all natural waters in the UK such as surface water (rivers, streams, lakes, reservoirs, ditches, ponds), including those temporarily dry, and groundwater (aquifers), as well as coastal waters up to three miles from the coastline. It is an offence to pollute such waters. Responsibility for policing controlled waters is placed with the regulators,

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	who may be the Environment Agency (EA), SEPA, Natural Resources Wales (NRW) or Northern Ireland Environment Agency (NIEA).
Contaminated land	Land that meets Part IIA of the Environmental Protection Act 1990 in England, Wales, and Scotland. In Northern Ireland, the contaminated land regime, which is set out in Part III of the Waste and Contaminated Land (Northern Ireland) Order 1997, has been enacted but is not yet in force. Under the Order, any land that appears to the local authority/ local council in whose area it is situated to be in such a condition by reason of substances in, on or under the land, that: 1 Significant harm is being caused or there is a significant possibility of such harm being caused. 2 Pollution of controlled waters is being or is likely to be caused.
Contaminant pathway receptor linkage	The relationship between a contaminant, a pathway, and a receptor. In England, Wales, and Scotland, this needs to exist for sites that are considered 'contaminated land'.
Corporate social responsibility	A self-regulation business model where a company seeks to play a positive role in the community and consider the environmental and social impact of business decisions.
Cultural heritage	Physical artefacts and intangible attributes of society that are inherited from past generations.
Duty of care for waste	A legal responsibility to ensure that production, storage, transporting and disposal of business waste is carried out without harming the environment.
EU ecolabel	European award for products and services that meet the highest environmental standards.
Ecology	All living things, such as trees, flowering plants, insects, birds and mammals, and their habitats.
Ecosystem	An ecological system of any scale, consisting of communities of organisms interacting with their environment.
Enforcement notice	In England, Wales, Northern Ireland and Scotland,

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	the environmental regulator has the power to serve a works notice/consent on a site to prevent or remedy water pollution. These can be served before pollution has occurred if, in the opinion of the environmental regulator, a polluting substance is likely to enter surface waters or groundwater. The environmental regulator may serve a works notice/consent to ensure that waters are cleaned up after pollution has occurred (EA, 2022a, SEPA n.d., NRW, 2022a).
Environmental indicator	A measure of an environmental parameter, which can be used to assess the present state of the environment by looking at trends over time.
Environmental management plan	A project-specific plan developed to ensure that all necessary measures are identified and implemented to protect the environment and comply with environmental legislation. The plan should be continuously updated throughout the project capturing alteration and mitigation effects.
Environmental receptor	Any feature, habitat, area or living organism that potentially can be affected by site activities.
Geoarchaeology	Using earth sciences, such as geology and geography, to understand archaeological record.
Greenfield	Sites where no residential, industrial, and commercial development or activities have taken place.
Greenhouse gases	Naturally present and artificial gases that contribute to the greenhouse effect. These gases include carbon dioxide, nitrous oxide, methane, and chlorofluorocarbons. See BEIS (2019) and guidance by Department for Environment, Food and Rural Affairs (Defra, 2023a).
Greywater	Lightly contaminated water captured and reused for a secondary purpose, eg water from wash basins used to flush toilets.
Ground investigation	A process that includes the collection and analysis of data to determine the risk of a site. It usually includes both geotechnical and geoenvironmental aspects. Also known as site investigation.
Groundwater	Water found beneath the ground's surface (ie

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	underground) in aquifers – rocks, sands, and gravels.
Groundwater source protection zones	Zones defined by the EA and NRW where there is a risk of contamination from any activities that might cause pollution in the area affecting a groundwater source used for drinking water. The closer the activity is to the source, the greater the risk. There are no groundwater source protection zones in Northern Ireland. In Scotland, the whole country is designated as a drinking water protected area under a River Basin Management Plan (The Water Intended for Human Consumption (Private Supplies) (Scotland) Regulations 2017).
Habitat	The place where an organism lives, often defined by the uniformity of vegetation (woodland, reedbed etc).
Hazardous ground gases	Gases from the ground that will cause harm to humans, ecology, and structures, particularly in confined spaces. Examples include radon, carbon dioxide, methane, and volatile organic compounds (VOCs).
Heritage bodies	English Heritage, Cadw, Historic Scotland and the NIEA have a general duty to conserve heritage, to carry out the scheduling of historic remains, and to undertake research.
Local biodiversity action plan	Used by local authorities and others to identify ecological objectives and targets. Aimed at ensuring sustainable development in relation to processes such as planning, a plan helps conserve and save valuable habitats as well as plant or animal species. Each local plan is linked to the UK Biodiversity Action Plan set by the government.
Mitigation	The actions and measures that may be taken to eliminate or reduce the impact of a scheme's development or operation.
Nature conservation body	Natural England, NRW, NatureScot, and NIEA have regional responsibility for promoting the conservation of wildlife and natural features.
Noise abatement zones	Local authorities have the power to set up a noise abatement zone as an area-based approach for controlling commercial and industrial noise.

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Non-licenced work	Works with asbestos that, under CAR 2012, do not need a licence. For example, cleaning up small quantities of loose/fine debris of ACMs (where the work is sporadic and of low intensity, the control limit will not be exceeded and it is short duration work), drilling of textured decorative coatings for installation of fixtures/fittings etc (see HSE, n.d.1).
Non-road mobile machinery	Mobile machines and transportable industrial equipment or vehicles that are fitted with an internal combustion engine and not intended for transporting goods or passengers on roads.
Persistent organic pollutants	Poisonous chemical substances that break down slowly and get into food chains that have restrictions on use, storage, and disposal (EA, 2021b).
Polluter pays principle	A principle whereby those who produce the pollution should bear the cost of managing the consequences.
Pollution	Any emission because of human activity that may: • be harmful to human health or the quality of the environment • cause offence to a human sense • result in damage to material property • impair or interfere with amenities and other legitimate uses of the environment.
Prescribed processes	Any activities carried out on premises, or by means of mobile plant (eg concrete crusher), capable of causing pollution to the environment. Usually requires a local authority or environmental regulator licence/permit.
Protected species	Plants and animals that are protected by law, ie it is illegal to kill, injure or capture/remove these species.
Recycling	Collecting and separating materials from waste and processing them to produce useable products.
Remediation notice(s)	Having identified any contaminated land within its area, the environmental regulator or the local authority may serve this notice on an 'appropriate person', specifying what needs to be done to remediate the land and the timescale for it to be done.
Remediation strategy	A strategy that describes how to meet and carry out

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	the remediation objectives (EA, 2021c).
Section 60 notice	Legal enforcement action issued by the local authority to control noise pollution and nuisance on construction sites. If raised, the conditions must be complied with until revoked or successfully appealed against.
Section 61 consent	An agreement with the local authority issued to permit activities with the potential to cause nuisance (eg noise on site to occur).
Sewerage provider	Regional wastewater utility company responsible for removal and treatment of foul water/sewage. For Scottish residents this is Scottish Water, and the NIEA in Northern Ireland.
Soakaway	A mechanism where foul or excess water is discharged and percolated through it back into the surrounding soil. This could be a series of perforated pipes laid in trenches in an area of land or plastic modular storage cells placed in a pit (MHCLG, 2009).
Sporadic and low intensity	*"Sporadic and of low intensity if the concentration of asbestos in the air should not exceed 0.6f/cm³ measured over 10 minutes"* (HSE, n.d.l).
Statutory consultees	Organisations that must be consulted at the planning stage of projects. These include regulators, heritage bodies and nature conservation bodies.
Sustainable development	*"Development that meets the needs of the present without compromising the ability of future generations to meet their own needs"* (Brundtland, 1987).
Sustainable timber	Wood that is obtained from a sustainably managed forest.
Toolbox talks	Short presentations or meeting that are used for training construction professionals to do a particular task or job.
Trade effluent consent	A consent that must be sought from the relevant water and sewerage company or authority before an organisation can discharge trade effluent to a public foul sewer or to a private sewer that connects to a public sewer.
Transfer document	Required as legal evidence describing the transfer of inert and non-hazardous waste between duty holders.

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Transfer station	Facility where waste is transferred from collection vehicles to larger vehicles or onto rail or river for onward transport for disposal. Also refers to a facility that segregates waste.
Translocation	The physical removal of either an area of habitat or a number of individuals of a certain species from one site (the donor site) to another (the receptor site).
Waste	Any substance or object that the holder discards, intends to discard or is required to discard: • controlled waste – household, commercial and industrial waste • directive waste – material that the producer or holder discards • inert waste – material that does not undergo any significant physical, chemical, or biological transformations. Inert waste will not dissolve, burn, or otherwise physically or chemically react, for example, clean bricks or concrete: • non-hazardous waste – material that does not have any significant hazardous properties but is not inert and could cause issues if not dealt with properly because it may biodegrade, for example, paper, cardboard or plastic. • hazardous/special waste – can be harmful to the environment and human health and may require additional measures when handling or be limited as to how such materials (eg paints, solvents, oil, and pesticides) may be safely disposed of.
Waste acceptance criteria	Criteria for deciding what types of landfill the waste should be disposed to (EA, 2021d).
Waste classification	Process to determine the List of Waste code for a waste and whether the waste possesses hazardous properties.
Waste holders	People or organisations who hold or store waste.
Watching brief	The process by which a relevant professional person inspects construction activity and works for compliance with legislative requirements, good practice, and any previously agreed MS or conditions.

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Wildlife corridor A linear habitat, or range of habitats, in which species can survive, and along which they can move to other wildlife areas. Examples include rivers and streams, hedges and shelterbelts, field, and road margins.

Works notice See *Enforcement notice*.

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Abbreviations and acronyms

ACM	Asbestos-containing material
AONB	Area of Outstanding Natural Beauty
ASSI	Area of special scientific interest (Northern Ireland)
BCT	Bat Conservation Trust
BIM	Building Information Modelling
BNG	Biodiversity Net Gain
BOT	Build-operate-transfer
BPM	Best practicable means
BRE	Building Research Establishment
BREEAM	Building Research Establishment Environmental Assessment Method
BS	British Standard
CAR 2012	The Control of Asbestos Regulations 2012 (No. 632)
CCS	Considerate Constructors Scheme
CCTV	Closed-circuit television
CEDaR	Centre for Environmental Data and Reporting (for Northern Ireland only)
CHAS	Contractors Health and Safety Assessment Scheme
CIfA	Chartered Institute for Archaeologists
CL:AIRE	Contaminated Land: Applications In Real Environments
CoC	Chain of Custody
COPD	Chronic obstructive pulmonary disease
COSHH	Control of Substances Hazardous to Health Regulations 2002
CWS	County Wildlife Sites
DBFO	Design-build-finance-operate
DDT	Dichlorodiphenyltrichloroethane
D&B	Design and build
Defra	Department for Environment, Food and Rural Affairs
DoW CoP	Definition of Waste: Code of Practice (CL:AIRE)
DREAM	Defence Realm Environmental Assessment Methodology

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edoc	Electronic duty of care
EEE	Electrical and electronic equipment
EHO	Environmental health officer
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EMS	Environmental Management System
ETI	Ethical Trading Initiative
EU	European Union
EWC	European Waste Catalogue
FBA	Furnace bottom ash
FSC	Forest Stewardship Council
GB NNSS	GB Non-native Species Secretariat (Great Britain only)
GCB	Green Construction Board
GHG	Greenhouse gas
GRI	Global Reporting Initiative
HWCN	Hazardous Waste Consignment Note
HMRC	HM Revenue and Customs
HSE	Health and Safety Executive
IAQM	Institute of Air Quality Management
IAI	Institute of Archaeologists of Ireland
IBA	Incinerator bottom ash
IHBC	Institute of Historic Building Conservation
INNS	Invasive non-native species
ISO	International Organization for Standardization
JIT	Just-in-time
KPI	Key performance indicator
LCRM	Land contamination risk management
LEED	Leadership in Energy and Environmental Design
LLFA	Lead local flood authority
LNR	Local Nature Reserve
LoW	List of Waste
LPA	Local planning authority
MDF	Medium density fibreboard

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MS	Method statement
NGO	Non-governmental organisation
NIEA	Northern Ireland Environment Agency
NNR	National Nature Reserve
NRMM	Non-road mobile machinery
NRW	Natural Resources Wales
PCB	Polychlorinated biphenyls
PEFC	Programme for Endorsement of Forest Certification
PFA	Pulverised fuel ash
PFI	Private finance initiative
PPC	Pollution prevention and control
PPE	Personal protective equipment
PR	Public relations
PV	Photovoltaic
PVC	Polyvinyl chloride
RAMSAR	Convention on Wetlands of International Importance Especially as Waterfowl Habitat
RCS	Respirable crystalline silica
RIGS	Regionally Important Geological Sites
RMP	Resource management plan
RPE	Respiratory protective equipment
RSPB	Royal Society for the Protection of Birds
SAC	Special Area of Conservation
SALI	Sporadic and low intensity
SEPA	Scottish Environment Protection Agency
SIC	Standard Industrial Classification
SINC	Site of Importance for Nature Conservation
SLINC	Site of Local Importance for Nature Conservation
SLNCI	Site of Local Nature Conservation Importance
SNCI	Sites of Nature Conservation Interest
SNCO	Statutory Nature Conservation Organisation
SPA	Special Protection Area
SSSI	Sites of Special Scientific Interest

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STEL	Short-term exposure limit
SWMP	Site waste management plan
TMP	Traffic management plan
TPO	Tree Preservation Order
UKCG	UK Contractors Group
UKGBC	UK Green Building Council
UXO	Unexploded ordnance
WAC	Waste acceptance criteria
WAP	Waste acceptance procedures
WEEE	Waste electrical and electronic equipment
WHS	World Heritage Site
WTN	Waste transfer note
WWF	World Wide Fund for Nature

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Every construction project has environmental requirements that need to be well-managed by the site manager and workers on site.

CIRIA C741 *Environmental good practice on site guide (fourth edition)*, which was published in 2015, provides essential guidance to site managers. The construction industry has come under increasing pressure to reduce negative environmental impacts. With the introduction of the Environment Act 2021, construction projects are expected to be carried out at higher environmental standards and achieve new national environmental commitments ,such as net zero emission by 2050.

This guide provides up to date practical guidance on delivering sustainable construction at the site level, which includes:

- ecology, protected species and habitats
- historic environments and archaeological remains
- land contamination
- nuisance (eg noise, vibration, lighting, dust, emissions, odours)
- resources (eg energy, materials, water and waste)
- traffic and travel arrangements, and vehicle use.



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