

Guidance on the management of landfill sites and land contamination on eroding or low-lying coastlines

*N J Cooper, G Bower, R Tyson, J J Flikweert,
S Rayner and A Hallas of Royal Haskoning DHV*



Classic House, 174–180 Old Street, London EC1V 9BP

Tel: 020 7549 3300

Fax: 020 7253 0523

Email: enquiries@ciria.org

Website: www.ciria.org

Guidance on the management of landfill sites and land contamination on eroding or low-lying coastlines

Cooper, N J, Bower, G, Tyson, R, Flikweert, J J, Rayner, S, Hallas, A

CIRIA

C718

© CIRIA 2012

RP963

ISBN: 978-0-86017-721-0

British Library Cataloguing in Publication Data

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

Keywords Contaminated land, environmental good practice, remediation, risk mitigation, vapour intrusion, vapour migration, remediation verification, gas	
Reader interest This guidance is intended for anyone involved in: <ul style="list-style-type: none">◆ management of sea flooding and coastal erosion risks◆ land use or spatial planning at, or near, the coast◆ owning, operating or regulating a landfill site or area of land contamination at, or near, the coast. <p>This includes (but is not restricted to) flood and coastal managers, land use planning and development control officers, contaminated land officers, waste regulators, site managers from local authorities, Environment Agency, Environment Agency Wales (until April 2013), Natural Resources Body for Wales (from April 2013), Scottish Environmental Protection Agency, Northern Ireland Environment Agency, Department for Environment, Food and Rural Affairs (Defra), Scottish Government, Welsh Government, Northern Ireland Assembly, Department of Agriculture and Rural Development (DARDNI), Marine Management Organisation (MMO), Marine Scotland, Natural England, Centre for Environment, Fisheries and Aquaculture Science (Cefas), Single Environmental Body Wales (from April 2013), Scottish Natural Heritage (SNH), Northern Ireland Environment Agency, Landfill site operators, Landowners (eg The National Trust, Ministry of Defence, private individuals, Coal Authority, The Crown Estate).</p>	Classification Availability Unrestricted Content Advice/guidance Status Committee-guided User Land owners, developers (commercial and residential), professional advisors/consultants (both engineering and environmental), builders and contractors, regulators (EA, SEPA, NIEA, local authority and building control) and other professional and non-specialist stakeholders

Published by CIRIA, Classic House, 174–180 Old Street, London, EC1V 9BP, UK

This publication is designed to provide accurate and authoritative information on the subject matter covered. It is sold and/or distributed with the understanding that neither the authors nor the publisher is thereby engaged in rendering a specific legal or any other professional service. While every effort has been made to ensure the accuracy and completeness of the publication, no warranty or fitness is provided or implied, and the authors and publisher shall have neither liability nor responsibility to any person or entity with respect to any loss or damage arising from its use.

All rights reserved. No part of this publication may be reproduced or transmitted in any form or by any means, including photocopying and recording, without the written permission of the copyright holder, application for which should be addressed to the publisher. Such written permission must also be obtained before any part of this publication is stored in a retrieval system of any nature.

If you would like to reproduce any of the figures, text or technical information from this or any other CIRIA publication for use in other documents or publications, please contact the Publishing Department for more details on copyright terms and charges at: publishing@ciria.org Tel: 020 7549 3300.

Front cover photo: an historic landfill located at the coastal margin in north east England, where erosion results in the release of waste onto the foreshore. A scheme has since been completed to manage the risks from the coastal erosion (courtesy Nick Cooper, Royal Haskoning DHV)

Summary

This publication provides guidance on the management of landfill sites and areas of land contamination located on eroding or low-lying coastlines.

Over the years, processes of coastal erosion and sea flooding have resulted in waste from some sites being deposited on the foreshore or seeping into the coastal and marine environment, potentially resulting in a range of issues such as adverse effects on public health and safety or undesired physical, chemical and biological effects on the natural environment.

These are likely to be experienced more frequently as a consequence of the effects of climate change, especially sea level rise. This issue is likely to become a more common challenge to coastal managers and those responsible for coastal sites in the future.

This is an emerging issue and to date there has been limited experience of dealing with such problems from identification through to solution. This guide has been produced to help the increasing number of professionals who will come across such problems for the first time.

Introduction to the guide

This publication is aimed at the interface between the well-established industries of waste management, pollution prevention and control, and flood and coastal erosion risk management. Chapter 1 explains its relationship with existing guidance from those sectors and where this guidance addresses a unique area of overlap.

Part 1 Guidance framework

Part 1 of the guide presents the core guidance framework, which starts with a background context and then sets out the steps involved in identifying and managing the risks presented.

Chapter 2: background context provides an introduction to the main relevant legislative and regulatory instruments that may apply to sites covered in this guide. A route map is provided to help define roles and responsibilities of different stakeholders.

Chapter 3: identifying sites provides advice on how to determine whether known landfill sites or areas of land contamination are at risk of coastal erosion or sea flooding in the short- or long-term. Also, it provides advice on the steps to be taken should a formerly unidentified historic landfill or a previously unknown area of land contamination be identified by a third party.

Chapter 4: characterising site history and setting provides guidance on the desk studies and site visits that may be needed to understand a site's history, present-day characteristics and potential hazards and receptors.

Chapter 5: assessing the risk describes the process of risk assessment as a means of quantifying the hazards presented by the release of material from a site. This assessment process is based upon consideration of both the likelihood and the consequence(s) of a release occurring. The conceptual site model (CSM) is introduced, which identifies the source of a risk, receptors that could be affected if they come into contact with that source, and the pathways that may link the two. With a “source–pathway–receptor” CSM defined, quantification of the risk(s) can then be undertaken to inform the management approaches that need to be developed and delivered.

Chapter 6: appraising the options provides advice on the options that are available to manage the risks presented by erosion or sea flooding of sites and the approaches for assessing the relative technical, economic and environmental merits of each within the context of an “options appraisal”.

Chapter 7: delivering the solution provides guidance on important aspects to consider during both the design and approvals stage and the construction stage of those options previously introduced in Chapter 6, which involve construction works. This includes consideration of health and safety, and material handling, reuse and disposal.

Chapter 8: evaluating performance provides advice on the development and delivery of a monitoring plan to enable the performance of a scheme to be evaluated and its potential wider scale effects (both positive and adverse) to be assessed. Should the monitoring reveal that the risks are not adequately being addressed by the scheme, then guidance is provided to enable residual risks to be assessed and fed back into the management process.

Part 2 Perspectives

Part 2 of the guide presents a suite of perspectives recognising that individuals or organisations

may have different standpoints and responsibilities in relation to the subject of this guide. Each chapter in Part 2 provides a specific topic identified by stakeholders during development of the guide. These cover:

Chapter 9: strategic coastal management planning.

Chapter 10: landfill site managers.

Chapter 11: very long-term erosion.

Chapter 12: future sites or site extensions.

Chapter 13: rivers.

Part 3 Themes

Part 3 of the guidance addresses overarching themes which apply to several Chapters.

These themes could become outdated due to changes in statute, government policy etc. It is recommended that the reader obtains further advice from the appropriate government bodies at the relevant time. The themes cover the following topics:

Chapter 14: legislative and regulatory context.

Chapter 15: funding.

Chapter 16: approval mechanisms.

Chapter 17: stakeholders and their engagement.

Part 4 Case studies

Part 4 of the guide presents the following three case studies that illustrate practical application of differing aspects of the guidance:

Chapter 18: Trow Quarry, Tyne & Wear, covering erosion of an historic landfill located directly at the coastal margin.

Chapter 19 Spittles Lane, West Dorset, describing how a major landslip caused large quantities of waste to be released down the cliff face from an historic landfill located on the cliff top.

Chapter 20: Shoreline Management Plan, Essex, identifying how the presence of landfill sites and areas of land contamination behind existing defences and the presence of waste materials within the core of defences has affected selection of strategic coastal management policy along areas of low-lying shoreline within Essex.

Further reading

A further reading section is provided at the end of the guide. This gives information sources in relation to relevant UK legislation and existing industry guidance in flood and coastal management, environmental protection, contaminated land, and waste management.

Throughout the guide, mini case studies and other boxes are used to highlight particular points.

Acknowledgements

Authors

Nick Cooper BEng (Hons) PhD CEng FICE

Nick is a chartered civil engineer with around 20 years' experience in the management of coasts and estuaries. He has been involved with the development of Shoreline Management Plans, coastal strategies and coastal defence schemes around the UK.

Gary Bower BSc (Hons) MCIWM

Gary is a chartered waste manager with over 20 years' experience and has detailed knowledge of European Directives and Regulations and UK waste legislation. He has worked on the implementation of domestic waste legislation, and has acted as expert witness and provided expert reports in waste management prosecutions.

Ruth Tyson BSc (Hons) FGS

Ruth is an environmental consultant, specialising in contaminated land assessment, including the development of conceptual site models and detailed quantitative risk assessment. She has a wealth of site investigation experience covering landfill sites and areas of land contamination, including sites affected by coastal erosion.

Jaap Flikweert MSc

Jaap is a civil engineer with around 20 years' experience in flood and erosion risk management. He has worked with relevant authorities to develop Shoreline Management Plans for the low-lying East Anglian coast and is heavily involved in policy work and operational research and development on management of flood and coastal defence assets.

Steven Rayner BSc (Hons), AIEMA

Steven is an environmental consultant, specialising in Environmental Impact Assessment (EIA). He has working knowledge of the consents and permissions that are likely to be required to allow delivery of schemes, in addition to significant experience in contaminated land investigation and management at sites including historic landfills.

Alison Hallas MChem MRSC

Alison is an environmental consultant with experience in site investigation, appraisal and delivery of remedial options. She has completed landfill assessment and permitting projects including integrated pollution prevention and control (IPPC) permit applications, landfill gas modelling, nuisance risk assessments and landfill environmental monitoring.

Project steering group

Siobhan Browne	Natural England
Anne Jones	DEFRA
Mark Langabeer	Veolia Environmental Services (UK) plc
Andrew Nicholas	SITA
Pete Roberts	Environment Agency
John Shevelan	LLWR Ltd

Robin Siddle	Scarborough Borough Council
Owen Tarrant	Environment Agency
Richard Thomas (chair)	Independent Consultant
Gary Thompson	The Crown Estate
Emma Thomson	Environment Agency
Jim Wilkinson	Environment Agency

Corresponding members

Nick Dolan	The National Trust
Tony Flux	The National Trust
Jeanette Guy	West Dorset District Council
Tony Hanson	South Tyneside Council
Brendan McLean	Belfast City Council
Paul Robinson	Environment Agency
Shaun Robinson	Environment Agency

Other consultees

CIRIA would like to thank the following for contributions to specific aspects or sections of the guide:

Toni Archer	West Dorset District Council
Richard Beaven	University of Southampton
Niall Benson	Durham Heritage Coast
Mark Blair	Magnox
Amy Boucher	Pell Frischmann
Andrew Brown	Essex County Council
Peter Clarricoats	Cory Environmental
Beth Clayton	SITA
Anne Coles	Aberdeenshire Council
Paul Dale	Scottish Environmental Protection Agency
Rowan Devlin	East Riding of Yorkshire Council
Mark Donoghue	Royal Haskoning
Peter Elliott	Environment Agency
Charles Foreman	Environment Agency
Mark Glennerster	CH2M Hill
Rebecca Glos Williams	Sniffer
Sue Goodman	Environment Agency
Gary Graveling	Buro Happold
Carol Hall	Environment Agency
Gavin Johnson	Scottish Natural Heritage
Kirsty Klepacz	Havant Borough Council
Sue Lawrence	Scottish Natural Heritage
Darren Legge	Environment Agency
Emmer Litt	Countryside Council for Wales
Louise Merritt	Environment Agency
Andrew Miller-Varey	BAM Nuttall
Cedric Moon	Welsh Government
Paul Morrison	Scottish Environmental Protection Agency

Kathy Mylrea	Cameron McKenna
Paul Nathanail	University of Nottingham
Robert Nichols	University of Southampton
Andy Parsons	CH2M Hill
David Porter	Northern Ireland Rivers Agency
Paul Robinson	Environment Agency
Alex Pritchard	Scottish Environmental Protection Agency
Alistair Rennie	Scottish Natural Heritage
Lesley Row, Patricia Rowley	North Ayrshire Council
Wendy Shakespear	Fareham Borough Council
Abigail Singleton	Environment Agency
Edward Taylor	Naue Geosynthetics
Caroline Timlett	Havant Borough Council
Mark Toner	Scottish Environmental Protection Agency
Mike Walkden	Royal Haskoning
Neil Watson	Environment Agency
James Wilson	WPA Consultants
Steve Woolard	Christchurch and East Dorset Council

A total of 119 individuals from a range of regulators, advisors, landowners, government departments, landfill operators, consultancies and academia provided responses to an online questionnaire throughout November and December 2011, during the scoping phase of this guide.

CIRIA project managers

Owen Jenkins, Gillian Wadams and Lee Kelly.

Project funders

Environment Agency
National decommissioning Authority (NDA)
CIRIA Core members

Contents

Summary	iii
Introduction to the guide	iv
Acknowledgements.....	vi
Boxes.....	xii
Case studies.....	xii
Figures.....	xii
Tables	xiv
Glossary	xv
Abbreviations/acronyms	xx
1 Introduction	1
1.1 Background.....	1
1.2 Scope and purpose of the guidance.....	2
1.3 Relationship with existing guidance	3
1.4 Core principles of this guidance	4
1.5 Target readership.....	4
1.6 How to use the guidance	5
Part I Guidance framework	7
2 Guidance framework: background context.....	8
2.1 Introduction.....	8
2.2 Regulatory and legislative setting.....	8
2.3 Route map to defining roles and responsibilities	9
2.4 References	13
3 Guidance framework: identifying sites	14
3.1 Background.....	14
3.2 Known sites.....	14
3.3 Legacy sites	18
3.4 References	19
4 Guidance framework: characterising site history and setting	20
4.1 Background.....	20
4.2 Desk study	20
4.3 Site visit and limited sampling.....	25
4.4 References	28
5 Guidance framework: assessing the risk	30
5.1 Background.....	30
5.2 Potential sources	31
5.3 Potential pathways.....	36
5.4 Potential receptors.....	40

5.5	Risk assessment	42
5.6	References	47
6	Guidance framework: appraising the options.....	50
6.1	Background.....	50
6.2	Management options.....	50
6.3	Appraisal process.....	62
6.4	Preferred option	66
6.5	References	67
7	Guidance framework: delivering the solution.....	71
7.1	Background.....	71
7.2	Health and safety.....	71
7.3	Scheme design and assessment	72
7.4	Procurement of contractors.....	72
7.5	Construction supervision.....	73
7.6	Maintaining records	79
7.7	References	79
8	Guidance framework: evaluating performance and effects.....	80
8.1	Background.....	80
8.2	Monitoring plan.....	80
8.3	Performance of scheme.....	81
8.4	Potential wider effects.....	84
8.5	Evaluation	85
Part 2 Perspectives87
9	Perspective: strategic coastal management planning	88
9.1	Background.....	88
9.2	Managing the risks of sea flooding or coastal erosion to landfill sites and areas of land contamination within a strategic coastal management plan area	96
9.3	Effect of landfills or areas of contaminated land on management policy.....	91
9.4	Wider implications of management policy on landfill sites or areas of contaminated land in nearby areas.....	92
9.5	References	94
10	Perspective: landfill site managers	97
10.1	Background.....	95
10.2	Reactive issues – dealing with events	97
10.3	Proactive issues – protecting against future risk	99
10.4	References	100
11	Perspective: very long-term erosion.....	100
11.1	Background.....	101
11.2	Past coastal evolution	101
11.3	Contemporary coastal processes and climate	101
11.4	Future projections	102
11.5	Managing uncertainties.....	103
11.6	References	105

12	Perspective: future sites or site extensions.	105
12.1	Introduction	105
12.2	Operators and regulators	105
12.3	Local planning authorities	106
12.4	References	107
13	Perspective: rivers.	109
13.1	Differences in physical processes	109
13.2	Differences in roles and responsibilities	110
13.3	Differences in the process for managing landfills and contaminated land.	110
13.4	References	111
	Part 3 Themes	113
14	Theme: legislative and regulatory context.	114
14.1	Background	114
14.2	Landfill sites and areas of contaminated land	114
14.3	Pollution prevention and control	118
14.4	Coastal erosion and flood risk management	120
14.5	References	121
15	Theme: funding	123
15.1	Background	123
15.2	Legal responsibilities for funding remediation	123
15.3	Alternative mechanisms for funding	124
15.4	Further references	128
16	Theme: approval mechanisms	129
16.1	Background	129
16.2	Intrusive site investigation	130
16.3	Planning/design and construction	133
16.4	Relevant legislation during production of the ES	137
16.5	Further consent/licence requirements	139
16.4	Emergency works	140
16.5	References	142
17	Theme: stakeholders and their engagement	145
17.1	Introduction	145
17.2	Potential engagement aspects	145
17.3	Identifying potential stakeholders	148
17.4	Planning and delivering a stakeholder engagement approach	149
17.5	References	154
	Part 4: Case studies.	155
18	Case study: Trow Quarry.	156
18.1	Background	156
18.2	The problem	156
18.3	Options appraisal	157
18.4	Uncertainties and adaptability	158

18.5	Environmental issues.....	158
18.6	Construction phase	159
18.7	Post-scheme monitoring	160
19	Case study: Spittles Lane.....	162
19.1	Background.....	162
19.2	Landslip event and immediate response.....	162
19.3	Management plan	163
19.4	Management options.....	164
19.5	Preferred management option	164
20	Case study: Shoreline Management Plan, Essex.....	166
20.1	Background.....	166
20.2	Contaminated sites on the Essex coast.....	166
20.3	Effect on policy development	168
20.4	Actions and plans following the SMP	169
20.5	Lessons learnt	169
	Further reading	170
Boxes		
Box 2.1	Scale of the problem	15
Box 5.1	Source, pathway, receptor terminology	31
Box 5.2	Asbestos risks.....	33
Box 17.1	Key considerations of effective engagement.....	152
Box 17.2	Ten building blocks of effective engagement.....	153
Case studies		
Case study 4.1	Identifying historic sites in Christchurch Harbour, Dorset	23
Case study 4.2	Trow Quarry site visits	26
Case study 5.1	Radiation sampling in Dalgety Bay, Fife	35
Case study 5.2	Site investigations at Shoreham Gasworks	36
Case study 5.3	Historic landfill in Pagham Harbour, West Sussex.....	36
Case study 5.3	Halliwell Banks, Tyne & Wear	41
Case study 5.4	Colliery spoil, County Durham	44
Case study 6.1	West Sands, St. Andrews.....	52
Case study 6.2	Spittles Lane monitoring and clean-up.....	56
Case study 6.3	Blackdog Burn channel diversion	59
Case study 6.4	Trow Quarry economic appraisal.....	66
Case study 6.5	Hunterston, North Ayrshire	69
Case study 6.6	Brodick Beach, Isle of Arran	70
Case study 8.1	Trow Quarry monitoring plan	86
Case study 9.1	Greatham Creek slag bank	91
Case study 9.2	North-West Shoreline Management Plan.....	93
Case study 11.1	Dounreay shaft	104
Case study 11.2	Low Level Waste Repository, Cumbria	104
Figures		
Figure 1.1	Waste released onto the foreshore following a landslip in coastal cliffs in west Dorset.....	2

Figure 1.2	Domestic waste spilled onto the onto the foreshore at the eroding margin of an estuary in south-west England	2
Figure 1.3	Elements included within the scope of this guidance	3
Figure 1.4	Relationship with existing guidance	4
Figure 1.5	Cyclic management approach	4
Figure 1.6	Structure of the guidance	6
Figure 2.1	Legislative responsibilities for management of risks landfill sites or land contamination on eroding or low-lying coastlines	10
Figure 3.1	Erosion zones affecting a site in around 50 years	16
Figure 3.2	Flood zones affecting a site under different sea flooding events	17
Figure 4.1	Wash out of waste in north-east England during particularly high sea states and wave run up events	26
Figure 5.1	Conceptual site model	30
Figure 5.2	Hand augering	34
Figure 5.3	Cable percussive drilling	34
Figure 5.4	Waste directly exposed at undefended shore margin	37
Figure 5.5	Waste at or near cliff top or estuary bank released due to erosion or landslip	37
Figure 5.6	Waste set back from eroding (undefended) shore margin	38
Figure 5.7	Waste retained behind a coastal defence structure (sea wall) (may be land reclaimed from the sea)	38
Figure 5.8	Waste retained behind a coastal defence structure (embankment) (may be land reclaimed from the sea)	39
Figure 5.9	Waste retained behind a coastal defence structure (revetment) (may be land reclaimed from the sea)	39
Figure 5.10	Waste contained within a coastal defence or quay wall structure	39
Figure 5.11	Removal or breaching of flood embankment (or other coastal defence)	40
Figure 5.12	Eroding sea cliffs at Halliwell Banks	41
Figure 5.13	Landfill behind a limestone ridge at Halliwell Banks	41
Figure 6.1	Removing the source of the risk	51
Figure 6.2	Removing the waste or contaminated material	52
Figure 6.3	On-site treatment of waste or contaminated material	53
Figure 6.4	Breaking the pathway between source and receptor	55
Figure 6.5	Cover systems	56
Figure 6.6	Seawall creating a barrier between source and receptor	58
Figure 6.7	Rock revetment creating a barrier between source and receptor	58
Figure 6.8	Coastal defence structures providing a barrier at the coastal margin. Stone-filled gabion baskets (a), clay embankment (b), concrete sea wall (c), blockwork revetment (d), rock revetment (e)	60
Figure 6.9	Removing the receptor to avoid contact with the source	61
Figure 6.10	Signage used at Trow Quarry to reduce risks to human health	61
Figure 6.11	Warning signage to prevent receptor coming into contact with a source	61
Figure 6.12	Sand-filled geotextile bags being lifted into position	70
Figure 6.13	Sand-filled geotextile bags being layered to encapsulate the site	70
Figure 11.1	Successive responses of cross-shore profiles over a very long time	102
Figure 16.1	Summary of likely process to be followed during planning/design phase under the relevant legislation	133
Figure 18.1	Trow Quarry	156

Figure 18.2	Coastal erosion at Trow Quarry	157
Figure 18.3	Completed scheme at Trow Quarry	161
Figure 19.1	Spittles Lane landslip	163
Figure 20.1	Sites of contaminated land at flood risk within the Essex and South Suffolk Shoreline Management Plan area	167
Figure 20.2	Selection of contaminated sites identified within the Essex Shoreline Management Plan area	168

Tables

Table 4.1	Historical setting – potential further guidance/data sources	
Table 4.2	Present day setting – potential data sources/further guidance	
Table 5.1	Sites requiring specialist advice	
Table 5.2	Potential receptors	
Table 5.3	Generic risk categorisation (from Rudland et al, 2001)	
Table 5.4	Generic criteria for assessing the risk to the identified receptor from non-permitted sites	
Table 5.5	Likely risk assessments for a sample of potential cases	
Table 6.1	Indicative comparative cost ranges for coastal defence options	
Table 6.2	Considerations when selecting a preferred option	
Table 8.1	Available approaches to monitoring of scheme performance	
Table 16.1	Summary of potential consents and permissions that may be required before each phase of a potential scheme (note that this list is not intended to be exhaustive)	
Table 17.1	Typical stakeholder engagement for managing ongoing or imminent issues	
Table 17.2	Key potential external stakeholders	
Table 17.3	Understanding what can and cannot be influenced by stakeholders	
Table 17.4	Making engagement programmes stakeholder friendly	
Table 18.1	Effects and mitigation measures at Trow Quarry	

Glossary

Advance the line	Advancing the line of existing defence by building new defences on the seaward side of the original defences.
Aquifer	A geological formation containing or conducting groundwater.
Class A appropriate person	A polluter who can be traced.
Class B appropriate person	By default, this would be the landowner, where the Class A appropriate person cannot be traced.
Closed landfills	Landfill sites that are closed to accepting waste, but are going through aftercare and monitoring as part of the permit surrender process.
Coastal defence	A composite term comprising “coastal protection” and “sea defence”. A structure built to protect the land from erosion or flooding by the sea.
Coastal erosion risk mapping	Maps published by the Environment Agency/Natural Resource Body Wales that can be used to identify coastal erosion risks.
Coast protection authority	An authority that has powers to perform duties in connection with the protection of land in their area under the Coast Protection Act 1949.
Coast protection	Works to protect the coastline against erosion by the sea.
Conceptual site model	A representation, either graphical or textual, which sets out pollutant linkages between sources and receptors.
Contaminated land	Land which meets the Part IIA/Part III definition of contaminated, being: Any land that appears to the local authority in whose area it is situated to be in such a condition by reason of substances in, on or under the land, that: <ol style="list-style-type: none">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.
Controlled waste	Controlled waste as is defined in Section 75 (4) of the EPA 1990, meaning household, industrial and commercial waste or any such waste.
Controlled waters	Waters defined and protected under Section 104 of the Water Resources Act 1991. Waters include coastal waters, inland fresh waters and groundwaters.
Defra	The Department for Environment, Food and Rural affairs, which is responsible for flood and coastal management policy in England and Wales. Incorporates the former Ministry of Agriculture, Fisheries and Food.
Dilute and disperse	Landfill sites where no basal lining is present, constructed in line with the “dilute and disperse” principle, using local rock strata as a suitable means of attenuating landfill leachate. Widely used before c1980, phase out following the introduction by the (then) National Rivers Authority of the Groundwater Protection Policy in 1992.

Duty of care	A legal obligation imposed on an individual or organisation requiring that they adhere to a standard of reasonable care in situations where their acts or omissions could foreseeably harm others.
Enforcing authority	In relation to contaminated land other than a “special site”, the local authority in whose area the land is situated is the enforcing authority.
Environmental clerk of works	A person who has responsibility to check, oversee and advise on works undertaken on site.
Environmental Impact Assessment	An analytical process that examines the potential environmental consequences of a project.
Environmental Management Plan	Site-specific plans developed to ensure that all necessary mitigation measures are identified and carried out to protect the natural environment and comply with environmental legislation.
Environmental Statement	The output from the Environmental Impact Assessment process, which is submitted alongside an application for planning permission.
EU Habitats Directive (92/43/EEC)	European legislation on the conservation of habitats.
European Waste Catalogue	A list providing a six-digit code and waste description for individual waste streams according to what they are and how they were produced.
Flood zone maps	Maps published by the Environment Agency/Natural Resource Body Wales, which can be used to identify sea flooding risks.
Foreshore	The zone between the high water and low water marks, also known as the inter-tidal zone.
Free product	A substance that is present in the environment as a separate liquid phase, which is relatively immiscible with water.
Futurecoast	A major research and development study commissioned by Defra to provide projections of future coastal evolution in England and Wales to inform the development of the second generation of Shoreline Management Plans.
Groundwater source protection zone	The Environment Agency has defined several groundwater source protection zones for 2000 groundwater sources such as wells, boreholes and springs used for public water supply. The zones show the risk of contamination from any activities that might cause pollution in the area.
Hazard	In the context of this guidance, a hazard is defined as a substance in or under the land that has potential to be hazardous to human health or the environment.
Hazardous waste	Waste that is harmful to human health or the environment, either immediately or over an extended period of time. Hazardous wastes are identified with an asterisk on the List of Wastes (known as the European Waste Catalogue).
Historic landfill	A landfill site closed before 1994.
Inert	A sub-set of non-hazardous waste. Waste is considered inert if: <ul style="list-style-type: none"> 1 It does not undergo any significant physical, chemical or biological transformations.

	<ol style="list-style-type: none"> 2 It does not dissolve, burn or otherwise physically or chemically react, biodegrade or adversely affect other matter that it comes into contact with in a way likely to cause environmental pollution or harm to human health. 3 Its total leachability and pollutant content and the ecotoxicity of its leachate are insignificant and, in particular, do not endanger the quality of any surface water or groundwater.
Hold the line	Maintaining or changing the standard of protection to hold the existing defence line.
Land contamination	This term can cover a wide range of situations where land is in some way contaminated. Where certain criteria are met, a site may be determined as “contaminated land”, which has a specific legal definition under Part IIA of the EPA 1990.
Landfill Directive 1999	The aim of the directive is to prevent or reduce as far as possible negative effects on the environment. In particular the pollution of surface water, groundwater, soil and air, and on the global environment, as well as any risk to human health from the landfilling of waste, during the whole lifecycle of the landfill.
Landfill operator	The person who has control over the operation of the landfill.
Landfill regulator	The authority on whom functions are conferred by the Landfill Directive 1999.
Landfill tax	A tax on the disposal of waste at a landfill site that covered by a licence or permit under specific environmental legislation. It aims to encourage waste producers to produce less waste, recover more value from waste and to use more environmentally friendly methods of waste disposal.
Leachate	A solution, which is the result of the leaching process. The solution can contain soluble contaminants picked up when percolating or draining through waste.
Managed realignment	Allowing the shoreline to move backwards or forwards, with management to control or limit movement.
Monitoring plan	A plan designed to incorporate an appropriate suite of approaches that will specifically address issues that are pertinent to the nature of the site and the type of solution under consideration.
No active intervention	No investment in coastal defences or operations.
Non-hazardous waste	Waste that is considered to be not harmful. Non-hazardous waste is identified without an asterisk on the List of Wastes (known as the European Waste Catalogue).
Operational landfills	A landfill site that is accepting waste.
Orphaned linkage/ orphaned site	An orphan linkage may arise where the significant contaminated linkage relates solely to the significant pollution of controlled waters (and not to significant harm) and no Class A appropriate person can be found, where no Class A or Class B appropriate person can be found, or where those who would otherwise be liable are exempted by one of the relevant statutory provisions.
Overtopping	A process of water overflowing or overspilling the crest of coastal defences, which could result in tidal flooding.
Part IIA	Part IIA of the Environmental Protection Act 1990 (as amended)

(England, Wales, Scotland) which establishes a legal framework for dealing with contaminated land.

Part III	Part III of the Waste and Contaminated Land (Northern Ireland) Order 1997 establishes a specific contaminated land power, including a definition of contaminated land and a procedure for securing remediation when such land is identified.
Pathway	With regard to this guidance, a route by which a receptor is, or might be, affected by the waste or contamination.
Permitted landfill	A landfill that is permitted to accept waste (operational landfill) or that is closed but has yet to surrender its permit.
Pollutant pathway/linkage	The linkage connecting a contaminant source with a receptor.
Polluter	The party responsible for causing pollution.
Proportionality	Ensuring at each stage that the processes adopted and levels of investigation or assessment undertaken and management options selected are proportionate to the best available understanding of the risks (or the residual risks) that are presented.
Ramsar site	Designated under the Ramsar Convention 1971. The objective of this designation is to prevent the progressive encroachment into, and the loss of, wetlands.
Receptor	With regard to this guidance, a receptor is something (ie humans, organisms, ecosystems, property, or controlled waters) that could be adversely affected by the waste or land contamination.
Remediation strategy	A document that details all relevant pollutant linkages, release scenarios and the strategy for delivery of any remedial work or monitoring that is required to demonstrate that any pollutant linkages previously identified are adequately addressed.
Responsible person/body	Person(s) legal responsibly for the site or site activities (landowner, local authority, Nuclear Decommissioning Authority)
Risk assessment	The formal process of identifying, assessing and evaluating the health and environmental risks that may be associated with a hazard.
Sea defence	Structure, either natural or man-made, which protects the land against flooding by the sea.
Site of Special Scientific Interest	A statutory designation under the Wildlife and Countryside Act (WCA) 1981. Notified by Natural England (formerly English Nature), representing some of the best examples of Britain's natural features including flora, fauna, and geology.
Site operator	The operator of a landfill site.
Source	With regard to this guidance, a source is a substance that is in, on, or under the land, and that has the potential to cause significant harm to a relevant receptor, or to cause significant pollution of controlled waters (ie the solids, liquids or gases contained within the waste or resulting from the land contamination).
Special Area of Conservation	A designation aimed to protect habitats or species of European importance and can include marine areas. SAC designated sites are designated under the EU Habitats Directive (92/43EEC) and will form part of the Natura 2000 site network. All SAC sites are

	also protected as Sites of Special Scientific Interest, except those in the marine environment below mean low water.
Special Protection Area	A statutory designation for internationally important sites, set up to establish a network of protected areas for birds. Special Protection Areas are designated under the EU Birds Directive (79/409/EEC). All SPAs are also protected as Sites of Special Scientific Interest.
Special Site	A special site is any contaminated land which has been designated as such by virtue of Section 78C(7) or Section 78D(6) of the EPA 1990, and whose designation as such has not been terminated by the appropriate Agency under Section 78Q(4) of the EPA 1990.
Stakeholder	A person, group or organisation who affects or can be affected by an organisation's actions.
Stakeholder analysis	The process of identifying the stakeholders that are likely to affect or be affected by a proposed action, and sorting them according to their effect on the action and the affect the action will have on them.
Stakeholder engagement	The process(es) that an organisation takes to involve stakeholders in dialogue to find out what social and environmental issues surrounding an action matter most to them so as to improve decision making and accountability.
Storm surge	A change in predicted tidal level due to meteorological effects, such as atmospheric pressure or wave set-up. In the context of this guide, positive storm surges during periods of low atmospheric pressure could lead to increased risk of sea flooding at sites.
Surrendered landfills	Where the environmental regulator has accepted that the closed landfill no longer forms a risk and as a consequence has accepted that the permit is formally surrendered.
Tree Preservation Orders	A Tree Preservation Order is made by a Local Planning Authority to protect specific trees, a particular area or woodland from deliberate damage and/or destruction.
Waste acceptance criteria	The criteria to be met before waste is accepted at a landfill site.
Waste Framework Directive 2008/98/EC	An EU Directive that provides a general framework for waste management requirements and sets the basic waste management definitions for the EU.
Water Framework Directive 2000/60/EC	A EU Directive that aims to establish a framework for the protection of inland surface waters (rivers and lakes), transitional waters (estuaries), coastal waters and groundwater. Its primary focus is preventing deterioration and improving chemical and ecological water quality.

Abbreviations/acronyms

AA	Appropriate assessment
ABD	Areas benefiting from defences
AONB	Area of Outstanding Natural Beauty
AQAP	Air quality action plan
AQMA	Air quality management area
ATL	Advance the line
BAP	Biodiversity action plan
BAT	Best available technique
BCR	Benefit cost ratio
BGS	British Geological Survey
BS	British Standard
CAR	Controlled Activity Regulations (The Water Environment (Controlled Activities) (Scotland) Regulations 2011)
CFMP	Catchment Flood Management Plan
CDM	Construction design and management
CL:AIRE	Contaminated Land: Applications in Real Environments
CLEA	Contaminated Land Exposure Assessment
CoP	Code of practice
COPA	Control of Pollution Act 1974
COSHH	Control of Substances Hazardous to Health
CQA	Construction quality assurance
CSM	Conceptual site model
DCC	Dorset County Council
DCLG	Department for Communities and Local Government
Defra	Department for Food, Environment and Rural Affairs
DOE	Department of Environment
DWS	Drinking Water Standards
EA	Environment Agency
ECoW	Environmental clerk of works
EIA	Environmental impact assessment
EMP	Environmental management plan
EPA	Environmental Protection Act 1990
EPS	European protected species
EQO	Environmental quality objectives
EQS	Environmental quality standards
ER	Environment report
ERA	Ecological risk assessment
ES	Environmental statement
ESC	Environmental safety case
ESID	Environmental setting and installation design report
EU	European Union

EWC	European Waste Catalogue
FCERM	Flood and coastal erosion risk management
FCM	Flood and coastal management
FDGiA	Flood defence grant in aid
GAC	Generic assessment criteria
GI	Ground investigation
GSI	Geographical information system
HMSO	Her Majesty's Stationery Office
HSE	Health and Safety Executive
HTL	Hold the line
LCF	Landfill Communities Fund
LFD	Landfill Directive
LLFA	Local lead flood authority
LLWR	Low level waste repository
LPA	Local planning authority
LRTC	Lyme Regis Town Council
LWM	Low water mark
MAFF	Minister of Agriculture, Fisheries and Food
MCAA	Marine and Coastal Access Act 2009
MCU	Marine consents unit
MHW	Mean high water
MHWS	Mean high water springs
MLW	Mean low water
MLWM	Mean low water mark
MLWS	Mean low water spring
MMO	Marine Management Organisation
MoD	Ministry of Defence
MR	Managed realignment
NAI	No active intervention
NDA	Nuclear Decommissioning Authority
NIEA	Northern Ireland Environment Agency
ODPM	Office of the Deputy Prime Minister
PNEC	Predicted no effect concentrations
PPC	Pollution prevention and control
PPDO	Public path diversion order
PPE	Personal protective equipment
PPG	Planning Policy Guidance
PPS	Planning Policy Statement
PRoW	Public right of way
QMUL	Queen Mary University of London
RSPB	Royal Society for the Protection of Birds
rWFD	Revised Waste Framework Directive
SAC	Special Area of Conservation
SCAPE	Soft cliff and platform erosion
SEA	Strategic environmental assessment

SEPA	Scottish Environmental Protection Agency
SGV	Soil guideline value
SI	Site investigation
SMP	Shoreline Management Plan
SNH	Scottish Natural Heritage
SPA	Special Protection Area
SRDP	Scottish Rural Development Programme
SSSI	Site of Special Scientific Interest
UKAEA	UK Atomic Energy Authority
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UXO	Unexploded ordnance
VOC	Volatile organic compound
WAC	Waste Acceptance Criteria
WCA	Wildlife and Countryside Act 1981
WEWS	Water Environment and Water Services (Scotland) Act 2003
WDDC	West Dorset District Council
WFD	Water Framework Directive
WPA	Waste planning authorities

1 Introduction

1.1 BACKGROUND

There are hundreds of known landfill, industrial and other waste sites around the coasts and estuaries of the UK. Many are disused, often re-landscaped and underlying land that is accessible to the public. Over the years, the effects of coastal erosion and sea flooding have resulted in waste from some of these sites being deposited on the foreshore (see Figures 1.1 and 1.2) and seeping into the coastal and marine environment.

The release of such waste and other contaminated material can result in a range of issues on public health and safety, and cause adverse physical, chemical and biological effects on the natural environment.

These releases are likely to become more frequent as a consequence of climate change, especially sea level rise, and this issue will become a more common management challenge in the future.

The adoption of strategic coastal management plans such as Shoreline Management Plans (SMPs) and coastal strategies around England, Wales and parts of Scotland and Northern Ireland has brought this issue into sharper focus in recent years. Also, it has identified further sites that are now at risk from erosion or sea flooding, or may become so in the future.

While such instances are expected to increase, there is limited experience to date of dealing with these problems from identification to solution in coastal and estuarine environments. This guide has been produced to help the increasing number of professionals who will come across such problems for the first time.

Development of this guidance involved industry-wide consultation through a questionnaire survey and a stakeholders' workshop. This process emphasised several of points that have been reflected in the way the guide has been structured and written:

- ◆ the issue spans several disciplines – most notably waste management, pollution prevention and control, flood and coastal management, and spatial planning
- ◆ as well as having a technical focus, environmental, economic and social issues have an influence on the option adopted
- ◆ potentially, a wide range of stakeholders can be involved with differing regulatory, land ownership, environmental, commercial and other perspectives
- ◆ the process is not linear and often a local issue can be influenced by the broader regional objectives such as strategic coastal management plans and budget allocations. This can result in complex and iterative decision making
- ◆ the approaches taken to investigation, management or remediation should be proportionate to the risks that are presented.



Figure 1.1 Waste released onto the foreshore following a landslide in coastal cliffs in west Dorset (courtesy Jim Wilkinson, Environment Agency)



Figure 1.2 Domestic waste spilled onto the onto the foreshore at the eroding margin of an estuary in south-west England (courtesy Lesley Row)

1.2 SCOPE AND PURPOSE OF THE GUIDANCE

This guide provides good practice in addressing these issues in coastal, estuarine and harbour settings. Its intent is to inform coastal managers about issues associated with the release of waste from sites and to inform site managers about the risks posed by erosion and sea flooding.

The sites covered include:

- ◆ operational landfills– permitted sites that are accepting waste
- ◆ closed landfills – permitted sites that are closed to accepting waste, but are undergoing aftercare and monitoring as part of the permit surrender process
- ◆ surrendered landfills – formerly permitted sites where the environmental regulator has accepted that the closed landfill no longer forms a risk and as a consequence has accepted that the permit is formally surrendered

- ◆ historic landfills – legacy sites, many that pre-date environmental regulation
- ◆ other areas of land contamination – including sites formally determined as “contaminated land” under Part IIA of the Environment Protection Act 1990 in England, Scotland and Wales or Part III of the Waste and Contaminated Land Order 1997 in Northern Ireland. Also extending to other (non-determined) areas of legacy industrial activity, including areas of reclaimed land within port and harbour areas or flood embankments or coastal defences with waste buried in them.

The scope of the document is illustrated schematically in Figure 1.3. This figure shows the elements and physical processes operating within fluvial, estuary and coastal systems that are included (✓) or excluded (✗) from the scope of this guide.

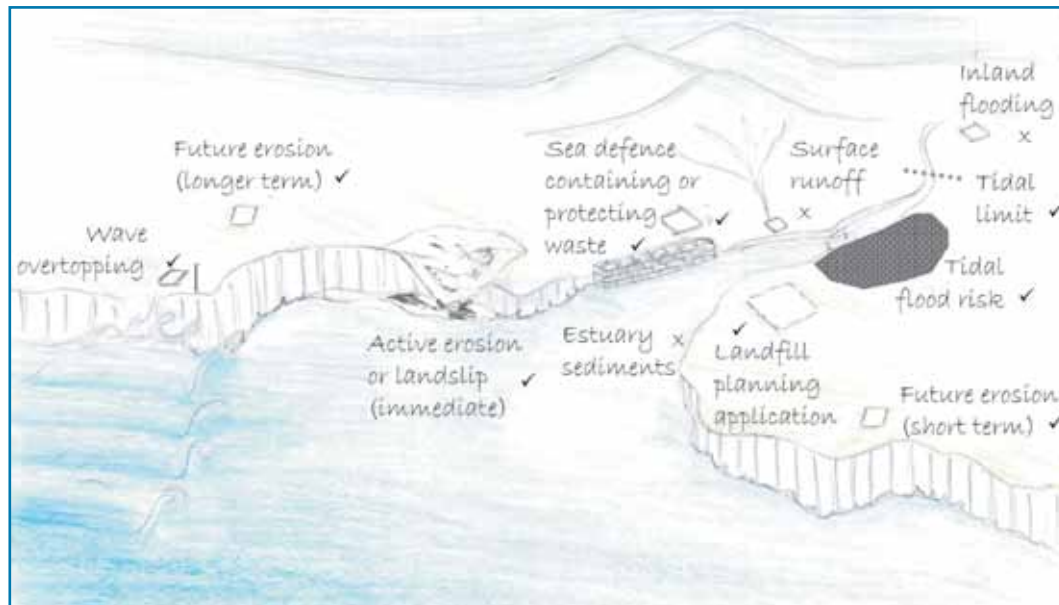


Figure 1.3 Elements included within the scope of this guidance

1.3 RELATIONSHIP WITH EXISTING GUIDANCE

There already exists a considerable volume of guidance of direct relevance to the waste management and pollution prevention and control (PPC) sectors, covering both the management of waste sites and the management of areas of land contamination.

There is further considerable guidance available directly to the flood and coastal management (FCM) sector on the management of risks from sea flooding and coastal erosion, including the appraisal of scheme options and the development of strategic coastal management plans, such as SMPs and coastal strategies.

This publication focuses on the unique area of overlap between these sectors (Figure 1.4), signposting to existing guidance and other reference material as appropriate. Also it recognises the environmental, economic and stakeholder perspectives that need to be considered.

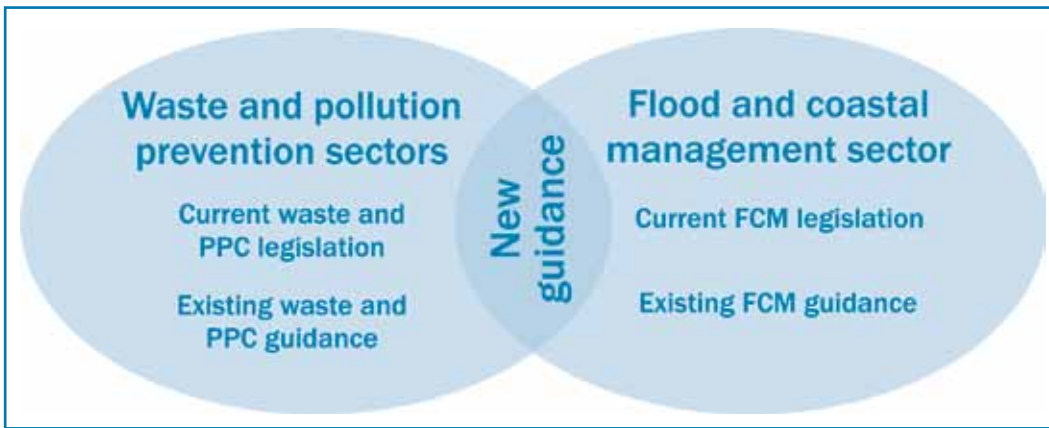


Figure 1.4 Relationship with existing guidance

1.4 CORE PRINCIPLES OF THIS GUIDANCE

The core of this guide is a framework based on a cyclic management approach involving the main stages presented in Figure 1.5.

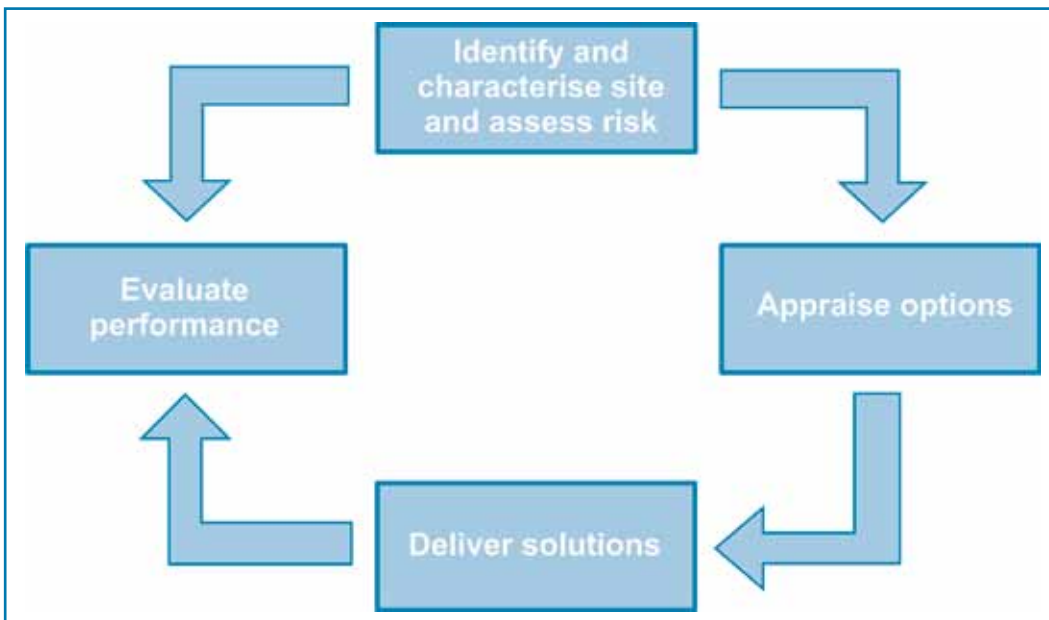


Figure 1.5 Cyclic management approach

The framework is founded on the principles of risk management throughout. These principles are already well known to both the waste and contaminated land industries and to the flood and coastal management industry. Linking strongly to this risk based approach, the framework also incorporates principles of proportionality, which ensures at each stage that the processes adopted and levels of investigation or assessment undertaken are proportionate to the best available understanding of the risks (or the residual risks) that are presented.

1.5 TARGET READERSHIP

This guidance is primarily aimed at those people with responsibilities for managing risks from coastal erosion and sea flooding affecting landfill sites or areas of land contamination, including:

- ◆ coastal managers who deliver their functions in relation to the rules set out in the Coast Protection Act 1949 for management of the risks posed by erosion of land and encroachment by the sea

- ◆ flood risk managers who deliver their functions in relation to the rules set out in the Water Resources Act 1991, Land Drainage Act 1991 and Flood and Water Management Act 2010
- ◆ landfill site operators and regulators who undertake or control the functions of operational and closed landfill sites in accordance with environmental permits
- ◆ contaminated land officers and environmental health officers who manage the risks presented by sites in accordance with their functions under various contaminated land regulations (covering solids, liquids, gases, and radioactive materials) and various pollution prevention and control legislation (covering water quality, air quality, noise and odour)
- ◆ scientific advisors to government who ensure compliance of activities and developments within the context of various environmental directives and regulations, especially those relating to nature conservation within the marine and coastal environment
- ◆ landowners who may have inherited historic or surrendered-license landfill sites or areas of legacy land contamination
- ◆ spatial planners responsible for development control and land use planning under the Town and County Planning Act 1990.

This guide is intended to provide practical advice to assist with the management of “on the ground” operational issues that may be faced now and in the future. It should be read alongside complementary advice on high-level and strategic planning of longer term issues addressed through strategic coastal management plans, such as SMPs and coastal strategies, waste management strategies and local development plans.

Given the unique nature of the problems covered in this guidance, it contains a wide range of different topics. Some readers may find it of value to read the entire guide, while others who already possess knowledge of a specific topic area may instead wish to refer to particular sections or subsections. For this reason the guidance has been structured to provide several different “entry points” depending on the needs of the user.

1.6 HOW TO USE THE GUIDANCE

The core of the guide is presented in **Part 1**. This describes the processes to be followed from identification of a problem, through characterising the site and assessing the risks, onto appraisal of options and delivery of a solution. It concludes with advice on the importance of evaluating performance and assessing residual risks on an ongoing basis.

In the specific case where erosion or sea flooding of a previously unknown or unidentified site is reported, the immediate steps to be taken by a coastal manager are provided in Section 3.3.

This core framework is supported by many other elements, which highlight potential “entry points” to the guidance. The way these inter-relate is shown in Figure 1.6.

Given the wide range of potential stakeholders, **Part 2** presents a perspectives section, which recognises that individuals will experience the issue from differing viewpoints and responsibilities and provides specific guidance from these perspectives.

Part 3 provides a suite of themes, which collectively cover important cross-cutting issues that can have an overall influence on the approach taken or can significantly affect the success (or otherwise) of an outcome.

Part 4 presents three main case studies that illustrate practical application of some of the main elements of the guidance.

The guidance concludes with a further reading section of useful guidance documents, online guides and relevant existing legislation.

Boxes are used throughout the guide to illustrate practical application of various processes within the framework through reference to a series of mini case studies. In addition, boxes and references listed within each chapter are used to direct the reader towards other literature sources for relevant legislation, existing complementary (more detailed) guidance documents and other useful information.

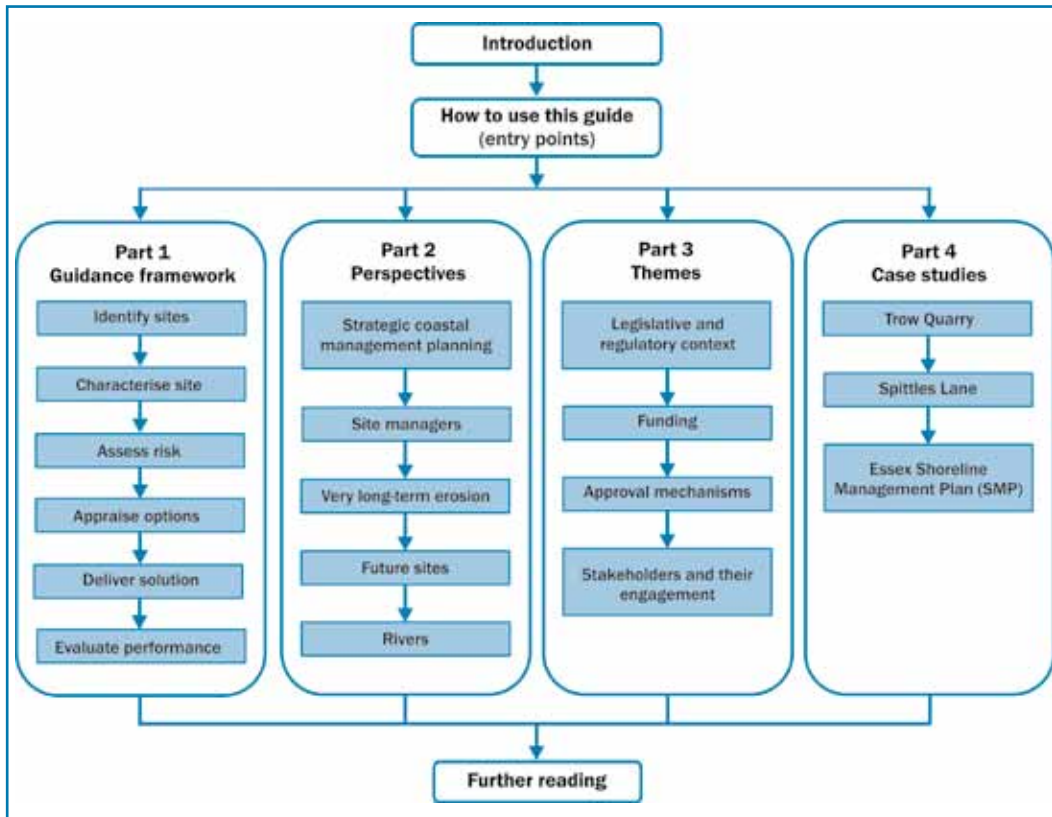


Figure 1.6 Structure of the guidance