Table 1.1 Sources of guidance on appraising flood and coastal erosion risk management schemes and plans

Source	Document	Purpose
HM Treasury	'Green Book'	Identifies the preferred approach to public sector investment appraisal
Defra	PAG series, particularly PAG3, plus addendums	How a project appraisal and CBA should be completed for flood and coastal erosion risk management projects
Middlesex University FHRC	The 'Multi-Coloured **Manual**' (MCM)	Gives details of relevant research and detailed guidance on benefit assessment methods and data
Middlesex University FHRC	The 'Multi-Coloured **Hand-book**' (MCH)	Summarises the guidance in the MCM for easier access

Table 1.3 Guidance provided by Defra on flood and coastal risk management project appraisal *

No	Title	Reference
FCDPAG1	Overview	Defra, 2001a
FCDPAG2	Strategic planning and appraisal	Defra, 2001b
FCDPAG3	Economic appraisal	MAFF, 1999
FCDPAG4	Approaches to risk	Defra, 2000a
FCDPAG5	Environmental appraisal	Defra, 2000b

* Supplementary guidance is also to be found at www.defra.gov.uk/environ/fcd

Table 1.4 Defra's prioritisation system for filtering schemes for detailed appraisal (Defra, 2005)

Score element	Derivation	Maximum score
Economic	The ratio of benefits to the cost of the scheme	20
People	The number of resi-dential properties that would benefit from the scheme (per £k of cost)	12
Environment	The area, in hectares, of designated habitat that would benefit from the scheme plus any net gain of habitat due to the scheme works (per £k of cost)	12

Table 1.2 Where to find what in the Manual

Topic	Theoretical perspectives	Appraisal methods	Data require-ments	Data, etc in the Manual	Analysis and interpretation	Lessons from experience
Flood risk management						
Assessing flood losses to residential property	4.2.1; 4.2.2	4.5	4.5	4.4	4.1	4.6
Indirect flood losses for residential property	Table 4.1			4.4		
'Intangible' flood losses to householders	4.4	Tables 4.15 and 4.19	Table 4.13; 4.14			
Flood losses for retail shops	5.2.2; Table 5.2	5.5, 5.6 and 5.8	5.7, 5.8 and 5.9	5.7, 5.8 and 5.9	5.7 and 5.9	5.11
Flood losses for offices and similar premises	Table 5.2	5.5, 5.6 and 5.8	5.7, 5.8 and 5.9	5.7, 5.8 and 5.9	5.7 and 5.9	5.11
Flood losses for industrial premises	Table 5.2	5.5, 5.6 and 5.8	5.7, 5.8 and 5.9	5.7, 5.8 and 5.9	5.7 and 5.9	5.11
Road traffic disruption during floods	6.3	6.3	6.3.1 to 6.3.3	6.3	6.3	6.3.4
Disruption to rail communications during floods	6.4.2	6.4.4	6.4.4	6.4.4	6.4.4	6.4.4
Emergency services costs	6.5; 6.5.1; 6.5.2;			6.5.4; 6.5.5		Case study: 6.5.3; 6.6
Agricultural benefits of flood risk management	9.2; 9.3; 9.5	Figure 9.2; 9.4; Figure 9.3	9.8; Table 9.11	Tables 9.4 and 9.5; Table 9.6	9.10; Figure 9.4	9.10; case study 9.11
Protection against erosion from the sea						
The nature of erosion benefits	7.2.1					
Methods of project appraisal: property losses	7.4.1	7.3	7.3.3; 7.4; 7.4.3	Tables 7.3, 7.4	7.4.2	
Methods of project appraisal: infrastructure losses	7.5.1 to 7.5.4	7.5.5; 7.6			7.4.2	7.7
Loss of agricultural land to the sea	Chapter 9					
Flood risk management and protection against erosion from the sea						
Recreational gains and losses: fluvial sites	8.2	8.3; Figure 8.1; 8.6.2	Table 8.1	Table 8.8 and 8.9 8.5	8.4, 8.5 and 8.6.2	8.8
Recreational gains and losses: coastal sites	8.2	8.3; Figure 8.1 8.6.1	Table 8.1	Tables 8.6, 8.7 and 8.10	8.4; 8.5 8.6.1 and 8.6.3	Case study: 8.7; 8.8
Environmental gains and losses	10.1 to 10.3	10.5		9.7 (agriculture); 10.7; Table 10.3	10.6	10.9

Table 2.1 Robustness analysis for flood alleviation options for Hubei and Hunan Provinces, China; numbers are $USm (Green, 2001)

Case	HUBEI			HUNAN
	Jianan	Wuhan	Babu	
Base	11.0	4.9	10.2	2.7
Delay benefits by 2 years	8.4	3.0	5.9	1.8
Probability of failure by existing dikes is lower	1.7	2.3	6.3	1.5
New dikes are not properly maintained	9.1	5.0	9.4	2.3
Bank protection works required every five yeas	8.0	4.9	10.1	1.2

Table 2.2 Critical parameters for some hypothetical 'do something' options (Source: adapted from Green, Parker and Tunstall, 2000)

	Options				
	A Source control	B Flood storage	C Channel Improvement	D Flood warning	E Dikes
Probability of failure on demand	●			●	●
Capital costs		●			●
Maintenance costs	●		●	●	
Effective scheme life	●				
Rate of increase in runoff					●

Table 3.1 Direct, indirect, tangible and intangible flood impacts, with examples

		Measurement	
		Tangible	Intangible
Form of loss	Direct	Damage to building and contents	Loss of an archaeological site
	Indirect	Loss of industrial production	Inconvenience of post-flood recovery

Table 3.2 Secondary indirect effects of floods: the case of the lower Thames area

Loss category		Damage and losses caused by a major flood (0.5 annual probability)		Size of economy: Input linkages (£m) (purchases from flood plain businesses)	Secondary indirect losses as percentage of input linkages
		Potential losses*	As percentage of direct damages		
Direct flood damage		£85,404,000	100.00%		
Indirect flood losses		£2,866,041	3.36%		
Secondary indirect effect:	Locality	£171,962	0.20%	86.73	0.20%
	Sub-region	£278,006	0.33%	140.25	0.20%
Loss of income from wages loss:	Sub-region	£68,000	0.08%	140.25	0.05%

* It is recognised that these figures are given in a form that is too precise; this is done for illustrative purposes only. For definitions, see text.

Table 3.3 The relationship in 1992 between flood probability and impacts for the Datchet to Teddington river Thames flood plain, UK (rounded) prior to Jubilee River.

Annual Probability of Flood Event	Number of Properties affected	Event damage (£000s)*
20%	440	1,200
11%	909	2,800
4%	5,200	13,000
1.7%	8,600	31,000
1%	10,400	49,000
0.5%	12,400	85,000

* 1992 values

Table 3.4 The impact of increasing flood depths by 100 mm for the Datchet to Teddington river Thames flood plain*

		A. + 10 cm	B. Best estimate	C. A/B (%)
1% annual probability flood	Capital sum (£M)	34.8	23.1	50.6
	Event Damage (£M)	64.3	49.3	30.4
	Properties affected	11,600	10,400	10.8
0.5% annual probability flood	Capital sum(£M)	41.4	30.2	37.1
	Event Damage (£M)	103.8	85.4	21.6
	Properties affected	13,600	12,400	9.2
PMF[a]	Capital sum (£M)	51.1	38.1	34.1

[a.] Probable Maximum Flood.
* All at 1992 values

Table 3.5 The system of Data Quality Scores (DQS)

DQS	Description	Explanation
1	'Best of Breed'	No better available; unlikely to be improved on in near future
2	Data with known deficiencies	To be replaced as soon as third parties re-issue
3	Gross assumptions	Not invented but deduced by the project team from experience or related literature/data sources
4	Heroic assumptions	No data sources available or yet found; data based on educated guesses

Table 3.6 The stages in the benefit assessment process for the Lower Thames study, with the progressive and iterative refinement of the data used and the consequent reduction in total Data Quality Score (DQS).

Iteration Number	TOTAL DQS	PVd £ millions	Data Characteristics								
			Water profile surface	Property threshold	DQS	Footprint Area	DQS	Land Use Code	DQS	Depth/ Damage Data	DQS
1	>9	1,229	2 water levels for 3 return periods; U/s level linked to D/s; with no intermediate	Lidar	4	Areas from MDSF mean values	3	NPD, no field checks	2	NPD Appx C	Various
2	>6	387	103 co-ordinates for 7 return periods	Mean of levelled thresholds within each of 20 sub-areas	3	OS Mastermap	1	NPD, no field checks	2	NPD Appx C	Various
3	>6	104	103 co-ordinates for 7 return periods	Mean of levelled thresholds within each of 20 sub-areas	3	OS Mastermap	1	First Field checks	1 & 2	NPD Appx C	Various
4	>6	90.2	103 co-ordinates for 7 return periods	Mean of levelled thresholds within each of 20 sub-areas	3	OS Mastermap	1	Further Field checks, reducing properties confirming land use	1 & 2	NPD Appx C	Various
5	8	91.6	103 co-ordinates for 7 return periods	Mean of levelled thresholds within each of 20 sub-areas	3	OS Mastermap	1	As iteration 4	1 & 2	Weighted Mean of all NRP D/ D in Appx C	2
6	>5	181	110 co-ordinates for 7 return periods with increased water levels	Mean of levelled thresholds within each of 20 sub-areas	2	OS Mastermap	1	As iteration 4	1 & 2	NPD Appx C	Various
7	>5	175	110 co-ordinates for 7 return periods with increased water levels	Mean of levelled thresholds from increased sample	2	OS Mastermap	1	As iteration 4	1 & 2	NPD Appx C	Various
8	>4 – 5	139	110 co-ordinates for 7 return periods with increased water levels	Threshold adjustments from Halcrow Lidar Analysis	1/2	OS Mastermap	1	As iteration 4	1 & 2	NPD Appx C	Various
9	>4 – 5	147	819 water Level Points for 7 return periods	Threshold adjustments from Halcrow Lidar Analysis with corrections to spurious georeferences	1/2	OS Mastermap	1	As iteration 4	1/2	NPD Appx C	Various
10	>4 – 5	132	819 water Level Points for 7 return periods. 7 sub-areas and water profile adjustments		1/2	OS Mastermap	1	As iteration 4	1 & 2	NPD Appx C	Various

Table 3.7 The impact of alterations to the return periods of appraised floods (River Irwell, Manchester, UK)

A			B			C			D			E		
Baseline case			Higher probability : threshold flood			Higher probabilities maximum flood			Higher probabilities overall: +10%			Lower probabilities overall: -10%		
Annual Pro-bability	Event damages *	Annual benefits **	Annual proba-bility	Annual benefits	% of base-line	Annual proba-bility	Annual benefits	% of base-line	Annual proba-bility	Annual benefits	% of base-line	Annual proba-bility	Annual benefits	% of base-line
11.1%	£0		20%	£0		11.1%	£0		12.3%	£0		10.1%	£0	
10%	£7,405,794	£41,143	10%	£370,290		10%	£41,143		11%	£45,715		9.1%	£37,403	
4%	£8,425,382	£516,078	4%	£845,225		4%	£516,078		4.4%	£573,421		3.6%	£469,162	
2%	£13,567,411	£736,005	2%	£1,065,153		2%	£736,005		2.2%	£817,785		1.8%	£669,096	
1%	£54,917,490	£1,078,429	1%	£1,407,578		1%	£1,078,429		1.1%	£1,198,257		0.9%	£980,391	
0.66%	£63,929,788	£1,276,507	0.66%	£1,605,657		0.66%	£1,276,507		0.7%	£1,418,345		0.6%	£1,160,463	
0.4%	£94,547,480	£1,487,810	0.4%	£1,816,960	122.1%	0.57%	£1,351,972	90.9%	0.44%	£1,653,126	111.1%	0.36%	£1,352,557	90.9%
Rectangle		£1,865,999		£2,195,149	117.6%		£1,892,246	101.4%		£2,073,336	111.1%		£1,696,366	90.9%
* These and comparable figures here are recognised to be over-precise, but are used for illustrative purposes														
** This is the area under the loss-probability curve at the extremes of flood probabilities (see Parker *et al*. 1987)														

Table 3.8 Above Design Standard (ADS) benefit results from appraisal of flood hazard problems on the River Thames, United Kingdom (1992 values)

River Thames reaches	Total annual average damages (to 0.5% annual probability flood)	Total residual flood damage post-scheme (1.7% annual probability standard)	Total ADS benefits (with 1.7% annual probability scheme standard)	ADS benefits as % of total realis-able benefits
Maidenhead, Windsor and Eton	£66.47M	£2.4M	£21.89M	34.18
Datchet, Wraysbury Staines and Chertsey	£34.84M	£1.1M	£10.61M	31.48

Table 3.9 Above Design Standard benefit results for the River Irwell, Salford, Manchester, United Kingdom

Scheme	Project description	Total 'do othing' annual average damages	Total residual flood damages	Total ADS benefits	ADS benefits as % of total realisable benefits
A	Two basin scheme (design standard 0.74% annual probability)	£27.16M	£0.71M	£6.76M	25.6
B	One basin scheme (design standard 1% annual probability flood)	£27.16M	£1.51M	£5.96M	23.3
C	Channel improve-ments only (design standard 2% annual probability flood)	£27.16M	£6.88M	£6.84M	33.7

Table 3.10 Indicative Standards of Protection (from FCDPAG3)

Current land use (for full description see FCDPAG3, page 62)	Indicative standard of protection (annual probabilities)	
	Tidal	Non-tidal
High density urban containing significant amount of both resi-dential and non-residential property.	0.5% to 2%	0.3% to 1%
Medium density urban. Lower density than above, may also include some agricultural land.	1% to 4%	0.5% to 2%
Low density or rural communities with limited number of properties at risk. Highly productive agricul-tural land.	2% to 20%	1% to 10%
Generally arable farming with isolated properties. Medium productivity agricultural land.	10% to 80%	5% to 40%
Predominantly extensive grass with very few properties at risk. Low productivity agricultural land.	> 40%	> 40%

Table 4.1 The range of possible flood impacts on households (not exhaustive or necessarily mutually exclusive)

Direct tangible losses to flooded households	Intangible losses to flooded households	Indirect losses to flooded households	Indirect losses to non-flooded households
▪ Damage to building fabric ▪ Damage to household inventory items ▪ Clean-up costs	▪ Worry about future flooding ▪ Loss of memorabilia and irreplaceable items and pets ▪ Damage to physical and/or mental health, death or injury ▪ Loss of community ▪ Loss of confidence in authorities and services	▪ Permanent evacuation from area ▪ Disruption to household due to flood damage ▪ Temporary evacuation costs ▪ Disruption due to flood warnings or alarms ▪ Loss of utility services ▪ Loss of income/ earnings ▪ Loss of leisure and recreational opportunities ▪ Additional communication costs ▪ Loss of services ▪ Increased travel costs ▪ Increased cost of shopping and recreational opportunities	▪ Increased travel costs ▪ Loss of income/earnings ▪ Loss of utility services ▪ Loss of other services ▪ Loss of leisure and recreational opportunities ▪ Increased cost of shopping and recreational opportunities

Table 4.2 Financial and economic damages related to household flood losses

Financial
Takes the standpoint of the individual household involved
Uses the actual money transfer involved to evaluate the loss or gain (e.g. if a household has a new-for-old insurance policy and they claim for a ten year old television, the loss is counted as the market price of a new television)
VAT is included as are other indirect taxes as they affect the individual household involved
Economic
Takes the standpoint of the nation as a whole – one person's loss can be another person's gain
Corrects the actual money transfer in order to calculate the real opportunity cost (e.g. in the case of the ten year old television, the real loss to the country is a ten year old television; the depreciated value of that ten year old television is taken as the loss)
VAT is excluded, as are other indirect taxes, because they are money transfers within the economy rather than real losses or gains

Table 4.3 Residential property: Building fabric and inventory components

Building fabric
Fabric of building, main and outbuildings (e.g. garage, shed) including decorations Electric light and power fittings but not appliances Fitted kitchens Plumbing installation and normal fittings Heating installation, including firing unit Power/gas supply to cooker but not the unit Boundary walls, gates and fences, landscape constructions but not horticultural layout
Inventory
Domestic appliances, heating equipment and electrical appliances (e.g. hi-fi equipment, microwave oven) Furniture and soft furnishings Personal effects (including books, clothes, etc.)

Table 4.4 Residential property: Building fabric susceptibility assumptions

Paths and paved areas, boundary fences etc.
▪ It is unlikely that any significant damage will occur to the main residential unit if the surrounding ground is submerged to a level below the air vents ▪ Swollen sub-soils may require repair to paths and paved areas ▪ Fences, sheds and greenhouses may become displaced ▪ Joint ownership of boundary fences should be ignored ▪ Repairs to lawns, gardens etc. are excluded
External main building
▪ Brickwork is unlikely to be damaged unless accompanied by severe frost ▪ Damage to mortar will increase with duration of flooding ▪ Damage to drains will increase with duration of flooding ▪ If water penetrates the sub-floor via air vents, floors will need to be lifted and disinfectant sprayed. The cost will be dependent on the number of sleeper walls ▪ The extent of damage to basements and cellars depends on their use. If for storage, drying and two coats of limewhite may be required. If for living, replastering and redecoration will be required ▪ Any external wall decoration will suffer damage under short or long duration floods ▪ Depth and duration will influence damage to external doors and architraves ▪ Apart from properties with basements, windows are unaffected until water reaches the sill at about 0.9m; short duration floods will not affect timbers, long duration will
Internal plasterwork
▪ Plasterwork absorbs water and the extent of damage depends on the depth and duration of flooding ▪ Modern building methods employ dry lining (gyproc). This is highly susceptible to flood damage and any contact with water involves complete replacement ▪ Stud partition walls absorb water and need to be replaced ▪ Brief immersion of plasterwork should not cause severe damage if the pre-flood condition was sound but prolonged immersion will saturate and renewal will be required ▪ Contaminated water will necessitate replastering ▪ Old lime plaster would be affected by short and long duration flooding ▪ For minor incidents, the area to be renewed might be two or three times the area exposed to contact, this will reduce the greater the flood depth ▪ Stud partition walls will be damaged for short and long duration flooding but the damage will be less extensive for short duration flooding
Floors
▪ Floor joist damage is unlikely to upper floors ▪ Floorboards should not be extensively affected on upper floors ▪ Short duration flooding will not affect softwood boards until 0.2m depth, greater depths will increase warping and sanding will be required ▪ Long duration flooding from 0.5m will affect soft and hardboards; the greater the depth of flooding the greater the anticipated damage ▪ Polished hardwood floors will increase resistance to penetration for several hours. Prolonged immersion would require sanding for soft and hardwood floors ▪ Damage to concrete floors should be no more than the cost of cleaning plus the possible application of a surface sealer. Cement and sand screeds and the insulation beneath them will be damaged by short and long term flooding ▪ Asphalt and composition floors are susceptible to flood damage as with concrete ▪ Damage to stone floors is likely to be related to the method of fixing and their pre-flood security ▪ Thermoplastic tiles will be seriously affected from 0.05m of flood depth in long duration flooding ▪ Long duration flooding will affect skirting from 0.05m of flooding
Joinery
▪ Door frames, architraves, doors and window sills are unlikely to suffer permanent damage from short duration flooding ▪ Long duration flooding on old doors will require repairs at levels below 1.2m and probably renewal at greater depths. For new doors flooding to 0.6m for a long duration flood will probably involve subsequent replacement ▪ Old doors would not require any repairs until 0.3m after short duration flooding and would not require replacement until above 0.9m

Table 4.4 Continued

- After short duration flooding new doors may require renewal at a flood depth of 0.3m
- Except in the case of the shortest duration, floor level fitted furniture is quickly affected beyond the economical cost of repair. For example, kitchen cupboard base units, either on legs or with chipboard partitions built down to floor level, are usually a complete write-off. If the chipboard does not expand immediately, it will in due course

Internal decorations

- Redecoration cannot normally be undertaken to part walls or even part rooms
- Normal domestic maintenance costs are likely to be insufficient to cover flood damage because more extensive preparation is required. This additional cost would apply to damaged parts only. Above water levels no more work would be required than for normal maintenance
- Lining paper is recommended where new plasterwork joints may be visible
- After short duration flooding up to 0.3m oil paint will only need cleaning
- After short duration flooding above 0.3m and long duration flooding deeper than 0.05m walls will need repainting;
- Window sills and frames would only need cleaning after flooding to depths of 0.9m but above this level redecoration will be required

Plumbing, central heating and electrical installations

- Pipes are not likely to be impaired but lagging will need to be renewed beneath floor levels
- Flooding to a depth less than 1.2m will not affect sanitary fittings
- Most modern central heating boilers will be above the level reached by most floods but any boiler immersed in water whilst hot is likely to be destroyed
- Laggings are not easily renewed and relatively little damage is required before the level of uneconomical repair is reached
- If tests indicate that re-wiring is necessary, plugs, junction boxes and the like are often fit for re-use
- Damage to electrical installations is inevitable when flood water penetrates the consumer unit which is often positioned at relatively low levels. Complete re-wiring may then be necessary

Table 4.5 Residential property: Assumptions concerning inventory susceptibility

Domestic appliances
Any domestic appliance in contact with water, no matter for how short a period, immediately presents a health and safety hazard. This is particularly true for refrigerators and deep freezers. Where items may theoretically be repaired, as is the case of electric cookers and ovens, high labour costs mean that it is often cheaper to replace these items. Therefore, all domestic appliances once in significant contact with water are assumed to be written off.
Electrical goods
Any electrical goods in contact with water, no matter for how short a period, immediately present a health and safety hazard. All electrical items will have to be replaced on contact with water.
Furniture
Bedroom furniture, often made of chipboard, is usually a complete write-off. Upholstered furniture such as sofas and armchairs usually soak up water through the fabric or valance. This furniture will need to be replaced on contact with water. Most polished furniture such as dining room chairs and tables will quickly become defective once in contact with water.
Floor coverings, curtains and personal effects
Carpets once wet have very little chance of renewal. Vinyl sheet flooring cannot be successfully taken up and re-used. Thermoplastic tiles need to be removed as they will trap water in the floor screed and slow down the drying process. Both thermoplastic tiles and ceramic floor tiles are likely to lose their adhesion if under water for any length of time unless they have been laid with a waterproof adhesive. It is likely that soft furnishings, linen and clothes will be a total loss upon direct contact with flood waters.
Heating equipment
Radiators, gas fires and storage heaters can be repaired after contact with water but high labour charges will generally necessitate replacement. The electric pumps associated with gas and oil central heating systems will cut-out when affected with flood water and any repair is labour intensive. Central heating systems will be affected as outlined in Box 4.2.

Table 4.6 Depth and duration of flooding for standard depth/damage information

Two durations:		
Short	Above ground floor level for less than 12 hours	
Long	Above ground floor level for more than 12 hours	
Fifteen depths above and below ground floor level		
1	-0.3m	To include damage to sub-floor areas
2	0.0m	Ground floor level to include damage to floors
3	0.05m	To include damage to carpets and floor coverings
4	0.1m	To include superficial damage to both internal fabric and inventory items
5&6	0.2 & 0.3m	To include superficial damage to both internal building fabric and inventory items
7-15	0.6m to 3.0m	In incremental steps of 0.3m to include progressively more items of damage

Table 4.7 Assumptions in the development of depth/duration/damage matrices for building fabric items

▪ Damages represent contractors' prices for repair work without regard for pre-flood conditions. No attempt has been made to reduce these figures to account for betterment. Thus we judge that the full cost of repairs reflects true damage
▪ Where redecoration is required the full cost is not included as decorations are naturally replaced from time to time. Fifty% of the redecoration costs have been taken to represent an average true cost of flood damage
▪ The quality of replaced or repaired building fabric items is standard. No distinction between the cost of different quality items is included because this would not significantly affect the overall damage estimates. Labour costs remain the same irrespective of material costs
▪ The costs are averages and do not reflect regional variation. For the average price percentage difference in each region, appraisers are directed to apply the latest figures from the Office for National Statistics. For example, in 2004, the relative prices in London and the South East were 9.7% and 5.3% higher respectively (ONS, 2005)
▪ Standard sizes of building fabric items such as doors and windows have been assumed
▪ All the values exclude VAT

Table 4.8 Social class categorisation by occupation

Social Class AB	Upper middle and middle class: higher and intermediate managerial, administrative or professional
Social Class C1	Lower middle class: supervisory or clerical and junior managerial, administrative or professional
Social Class C2	Skilled working class: skilled manual workers
Social Class DE	Working class and those at the lowest level of subsistence: semi-skilled and unskilled manual workers. Unemployed and those with no other earnings (e.g. state pensioners)

Table 4.9 Inventory items for which a 50 % ARV would not be suitable

▪ Carpets and rugs, for example, have the potential for 'secondary use' and thus the percentage ARV is set at more than 50 %
▪ Where exchanges are often made before the end of an item's effective life, through fashion changes, an average depreciation at half-way through an item's life may be 60 % to even 80 % of its current replacement value: only 40 % to 20 % is then allowable as the percentage ARV
▪ The percentage ARV of books and pianos is highly variable and is more closely related to quality than for other items
▪ The percentage ARV for items recently entering the market has been set higher than 50 % due to these items being, in general, less than halfway through their lives

Table 4.10 Secondary data sources

Source	Type of data
Office of National Statistics (2001)	Ownership of consumer durables by social class
Office of National Statistics (2002a)	Expenditure on: books, toys, clothes, toiletries/ cosmetics
British Market Research Bureau (1998)	Ownership figures by social class – various household goods
British Household Panel Survey (1991-2000)	Expenditure on consumer durables by social class
Office of National Statistics (2002c)	Type and age of property by social class
Focus group questionnaire results (Bewdley, Ruthin and Banbury)	Susceptibility of household inventory items to different depths and durations of flood
Store Catalogues and Web sites	Inventory lists and prices of household goods
Survey of English Housing (2001)	Housing stock statistics
DTLR (2001)	Housing stock statistics
DETR (1996)	Housing stock statistics
Mintel (1999-2001)	Ownership figures by social class – various household goods
Key notes (2000)	Ownership figures by social class – various household goods

Table 4.11 Average clean-up costs at flood depths below 0.1m (Source: ARK Ltd.)

Clean-up component	Unit cost (£)	No. units	No. days	Other costs (£)	Total (£)
Pressure washer	30 p/d	1	1		30
Aquavac and transformer	30 p/d	1	1		30
Decontamination	100 p/d	2	2		200
Skip	176 p/w	1	7		178
Storage cabin	220 p/m	1	28	195 Delivery - 195 Collection	610
Blower heater	112 p/m	2	28		224
Air mover	180 p/m	2	28		360
Dehumidifier	340 p/m	4	28		1360
Labour costs					
Pressure washer	195 p/d		1		195
Aquavac	195 p/d		1		195
Decontamination	195 p/d		2		390
Carpet removal	195 p/d		2		390
Flooring removal	195 p/d		2		390
Skip loading	195 p/d		1		195
Dehumidifier maintenance	35 p/d		28		980
Total					**£5,725**
CPI update to 2005					**£5,988**

Table 4.12 Average clean-up costs at flood depths above 0.1m (Source: ARK Ltd.)

Clean-up component	Unit cost (£)	No. units	No. days	Other costs (£)	Total (£)
Pressure washer	30 p/d	2	2		60
Aquavac and transformer	30 p/d	2	2		60
Decontamination	100 p/d	3	3		300
Skip	176 p/w	2	7		352
Storage cabin	220 p/m	1	56	195 Delivery - 195 Collection	830
Blower heater	112 p/m	2	56		448
Air mover	180 p/m	2	56		720
Dehumidifier	340 p/m	4	56		2720
Labour costs					
Pressure washer	195 p/d		2		390
Aquavac	195 p/d		2		390
Decontamination	195 p/d		3		585
Carpet removal	195 p/d		2		390
Flooring removal	195 p/d		2		390
Skip loading	195 p/d		2		390
Dehumidifier maintenance	35 p/d		56		1960
Total					**£9,985**
CPI update to 2005					**£10,444**

Table 4.13 Factors contributing to the consequences of flooding on human health

▪ Characteristics of the flood event (depth, velocity, duration, timing, etc.)
▪ Type of property e.g. single storey, two storey etc
▪ The amount and type of property damage and losses
▪ Whether flood warnings were received and acted upon
▪ Previous flood experience and awareness of risk
▪ Any coping strategies developed following previous flooding
▪ Having to leave home and live in temporary accommodation
▪ The clean-up and recovery process and associated household disruption
▪ Frustration and anxiety dealing with insurance companies, loss adjusters, builders and contractors
▪ Pre-existing health conditions and susceptibility
▪ Increased anxiety over the possible reoccurrence of the event
▪ A loss in the level of confidence in the authorities perceived to be responsible for providing flood protection and warnings
▪ Financial worries (especially for those not insured)
▪ A loss of the sense of security in the home
▪ An undermining of people's place identity and their sense of self (e.g. through loss of memorabilia)
▪ Disruption of community life

Table 4.14 Physical and psychological health effects of flooding.

Physical and other health effects reported during, or immediately after, Easter 1998 and summer and autumn 2000 floods	Physical health effects reported in the weeks or months after Easter 1998 and summer and autumn 2000 floods	Psychological health effects reported in the weeks or months after Easter 1998 and summer and autumn 2000 floods
▪ Injuries from being knocked over by floodwaters or thrown against hard objects, or from being struck by moving objects ▪ Injuries from over-exertion during the flood (e.g. sprains) ▪ Hypothermia ▪ Fear of electric shocks (although none was reported) ▪ Cold, coughs, flu ▪ Headaches ▪ Sore throats or throat infections ▪ Skin irritations (e.g. rashes) ▪ Shock	▪ Gastro-intestinal illnesses ▪ Cardiac problems ▪ Respiratory problems (e.g. asthma, chest infections, pleurisy) ▪ Lacerations, abrasions and contusions ▪ Sprains and strains ▪ Skin irritations (e.g. rashes, dermatitis etc.) ▪ High blood pressure ▪ Kidney or other infections ▪ Stiffness in joints ▪ Muscle cramps ▪ Insect or animal bites ▪ Erratic blood sugar levels (diabetics) ▪ Weight loss or gain ▪ Allergies (e.g. to mould spores)	▪ Anxiety (e.g. during heavy rainfall) ▪ Panic attacks ▪ Increased stress levels ▪ Mild, moderate, and severe depression ▪ Lethargy/lack of energy ▪ Feelings of isolation ▪ Sleeping problems ▪ Nightmares ▪ Flashbacks to flood ▪ Increased use of alcohol or prescription (or other) drugs ▪ Anger/tantrums ▪ Mood swings/bad moods ▪ Increased tensions in relationships (e.g. more arguing) ▪ Difficulty concentrating on everyday tasks ▪ Thoughts of suicide

Table 4.15 Flood warning damage reduction

	Description	£(x)	%(y)	Calculation
A	Total potential damage (TPD)	30000	100	
B	Potenial inventory damage (PID)	15600	52	By*Ax
C	Moveable inventory damage	6396	41	Cy*Bx
D	Households in receipt of warning		38	
	Effectiveness of:			
E	<8 hours warning		55	
F	>8 hours warning		71	
	TPD saved by			
	< 8 hour warning	1337	4.5	Ay*By*Cy*Dy*Ey
	> 8 hour warning	1726	5.8	Ay*By*Cy*Dy*Fy
	PID saved by			
	< 8 hour warning	1337	8.6	Cx*Dy*Ey
	> 8 hour warning	1726	11.1	Cx*Dy*Fy

Table 4.16 Assessing the potential damage to residential properties and households

Level of analysis	Guidance	Data requirements	Direct/tangible method of assessment	Indirect/intangible method of assessment
Strategy	For rapid desktop appraisals. This provides first approximations which are useful to identify the areas where more detailed work is required	▪ No. of properties in benefit area ▪ Annual average direct damage ▪ Sector average direct damage ▪ Average indirect surrogate values ▪ Weighted average value of £200 per property per year for intangibles	▪ Annual average damages ▪ Sector average	▪ Surrogate values for indirect losses ▪ Intangible benefits
Pre-feasibility	For more detailed project appraisal information where further assessment of household loss potential is considered warranted	▪ Number, type and age of houses in benefit area ▪ Surrogate values for indirect losses ▪ Generalised standard data for type and age of houses ▪ Standard of protection (pre and post scheme) for intangible values	▪ Generalised standard residential depth/damage data	▪ Surrogate values for indirect losses ▪ Intangible benefits ▪ Vulnerability analysis where feasible
Full feasibility	For the greatest accuracy and detailed study of potential benefits using the most detailed of the standard data sets	▪ Number, type, age and social class of houses and householders in benefit area ▪ Detailed standard data for type, age and social class of houses and householders ▪ Surrogate values for indirect losses ▪ Standard of protection (pre and post scheme) for intangible values. ▪ Government Weighting Factors for distributional Impact analysis	▪ Detailed standard residential depth/damage data ▪ Distributional Impact analysis	▪ Surrogate values for indirect losses ▪ Intangible benefits ▪ Vulnerability analysis

Table 4.17 Weighted annual average damage calculations: residential property with no protection (where <0.1m = all sector residential damage figures at 0.05m – Appendix 4.1).

Flood frequency	Distribution of flood depths		Damage (£)	Weighted damage (£)
	M	%		
5 years	<0.1	81	10,973	8,888
	0.1-0.3	7	23,290	1,630
	0.3-0.6	11	27,687	3,046
	0.6-0.9	1	30,267	303
	0.9-1.2	0	32,153	0
	>1.2	0	33,040	0
			Total weighted damage	13,867
10 years	<0.1	50	12,783	6,391
	0.1-0.3	31	26,075	8,083
	0.3-0.6	10	30,762	3,076
	0.6-0.9	6	33,108	1,986
	0.9-1.2	2	34,895	698
	>1.2	1	35,669	357
			Total weighted damage	20,592
25 years	<0.1	45	12,783	5,752
	0.1-0.3	24	26,075	6,258
	0.3-0.6	22	30,762	6,768
	0.6-0.9	5	33,108	1,655
	0.9-1.2	4	34,895	1,396
	>1.2	1	35,669	357
			Total weighted damage	22,186
50 years	<0.1	32	14,592	4,670
	0.1-0.3	20	28,859	5,772
	0.3-0.6	21	33,837	7,106
	0.6-0.9	21	35,949	7,549
	0.9-1.2	4	37,638	1,506
	>1.2	3	38,299	1,149
			Total weighted damage	27,751
100 years	<0.1	22	14,592	3,210
	0.1-0.3	16	28,859	4,617
	0.3-0.6	26	33,837	8,798
	0.6-0.9	19	35,949	6,830
	0.9-1.2	12	37,638	4,517
	>1.2	6	38,299	2,298
			Total weighted damage	30,270

Return period (years)	Exceedence probability	Damage (£)	Probability of flood in interval	Mean damage (£)	Annual interval damage (£)
2	0.5	0			
			0.3	6,933	2,080
5	0.2	13,867			
			0.1	17,229	1,723
10	0.1	20,592			
			0.06	21,389	1,283
25	0.04	22,186			
			0.02	24,968	499
50	0.02	27,751			
			0.01	29,011	290
100	0.01	30,270			
			0.005	30,270	151
200	0.005	30,270			
				Weighted annual average damage	£6,027

Table 4.18 Weighted Annual Average Damages (WAAD) assuming variable threshold Standards of Protection (SoP) and increasing flood warning lead-times (£) (Using Annual Average Damage Figures from Table 4.17).

Existing SoP	No warning (£)	<8 hour warning (£)	>8 hour warning (£)
No protection	6,027	5,511	4,901
2 years	6,027	5,511	4,901
5 years	3,254	2,975	2,646
10 years	1,606	1,469	1,306
25 years	719	657	585
50 years	303	277	246
100 years	76	69	62
200 years	38	35	31

Table 4.19 Intangible benefits associated with flood defence improvements

	Standard of Protection After – AFP (RP in years)									
Standard of protection before – AFP (RP in Years)			0.007 (150)	0.008 (125)	0.010 (100)	0.013 (75)	0.020 (50)	0.033 (30)	0.05 (20)	0.1 (10)
	1	(1)	£278	£215	£200	£153	£73	£25	£12	£5
	0.1	(10)	£214	£210	£195	£148	£68	£21	£8	£0
	0.05	(20)	£206	£202	£188	£141	£60	£13	£0	
	0.033	(30)	£193	£189	£175	£128	£47	£0		
	0.020	(50)	£145	£142	£127	£80	£0			
	0.013	(75)	£65	£62	£47	£0				
	0.010	(100)	£18	£15	£0					
	0.008	(125)	£4	£0						

AFP = Annual Flood Probability
RP = Return Period
Annual Benefits = Damages (before) – Damages (after)

Source: Defra (2004)

Table 4.20 FHRC Social Flood Vulnerability Index (SFVI)

Index	Variables	Rationale	Data needs
Elderly (Over 75yrs)	Residents aged 75 and over as a proportion of all residents	The age of 75 was chosen because epidemiological research has shown that after this age there is a sharp increase in the incidence and severity of arthritis (and other conditions) and this illness is sensitive to the damp, cold environmental conditions that would follow a flood event	Small Area Census data
Lone parents	Single parents as a proportion of all residents	Previous Middlesex University research has shown that lone parents (of either gender) are badly affected by floods because they tend to have less income and must cope single-handedly with both children and the flood impacts, with all the stress and trauma that this can bring	Small Area Census data
Pre-existing health problems	Residents suffering from limiting long-term illness as a proportion of all residents	Research by Middlesex University has shown that post-flood morbidity (and mortality) is significantly higher when the flood victims suffer from pre-existing health problems	Small Area Census data
Financial deprivation	▪ Unemployment: unemployed residents aged 16 and over as a percentage of all economically active residents aged over 16 ▪ Overcrowding: households with more than one person per room as a percentage of all households ▪ Non car ownership: households with no car as a percentage of all households ▪ Non home ownership: households not owning their own home as a percentage of all households.	The financially deprived are less likely to have home contents insurance and would therefore have more difficulty (and take a longer time period) in replacing household items damage by a flood event	Small Area Census data

Table 4.21 Total weighted factors by social class group

Total Weighted Factors by Social Class			
AB	C1	C2	DE
0.74	1.12	1.22	1.64

Table 5.1 Risk exposure of community-based assets: number of properties located in Flood Zone 3

Type and probability of flooding	Public House	Commu-nity Centre	School/ College	Hospital	Surgery / Health Care Centre	Leisure Centre	Totals
Fluvial flooding - high risk, annual probability of 1% or greater	3,424	1,517	1,716	52	1,133	873	8,715
Tidal flooding – high risk, annual probability of 0.5% or greater	2,908	1,597	1,399	72	1,129	691	7,796
Source: EA, NPD 2004 and January 2005 Flood Zone 3							

Table 5.2 Developments and trends in non-residential property affecting flood damage potential

Developments and trends	Factors affecting developments and trends
Commercial/office sector	
Growth in demand for out-of-town business park space.	Shortage of accommodation in traditional city centres. Business parks now an essential feature in most regional centres. Government policy restricting out-of-town and 'greenfield' developments have led to a move 'back to the city' in some regional centres, but government policies within some cities have also led to the shortage of office space. Significant differences between locations and individual towns.
Varying levels of growth and/or expansion of particular types of businesses in England and Wales.	For example, within the South East (and the Greater M25 area in particular), great demand in the Western Corridor from the information technology and telecom sectors, plus leisure, retail, and the public sectors. The recognition of Europe's leadership in mobile telephone technologies has spurred this rapid growth within the telecom industry. Consolidation within the sector, and new industry structures emerging between technology, media and telecom companies (brought about by the internet), are the main driving factors.
Demand for office space from hi-tech companies. Major office campus sites.	The office of 1987 bears little resemblance to the 21st century office with the proliferation of call centres and computer based business. 'Hi-tech' suites of offices are becoming the norm. Out-of-town locations have been favoured by many occupiers as town centre congestion and car parking continues to be a problem. Demand for office space has been much lower in some areas than in others. For example, in parts of Kent, Sussex and Surrey there are few large 'brownfield' sites and developments are often unable to satisfy the requirements of large corporate occupiers for adequate-sized areas of land.
Significant cost differences between locations and individual towns.	For example, central London has the highest rents for office space in the country and is also said to be the most expensive in Europe for tenant fit-out costs - in some cases more than double the costs of other European cities.
Retail sector	
In-town retail	
High Street shops constitute the largest proportion of NRPs in the flood plains of England and Wales (23% in Flood Zone 3) both tidal and fluvial .	Retail shop and service premises have, on average, the highest flood damage potential per unit area of all properties, owing to the combination of high density, high stock value, and intense use of space. Many retail and service premises have been, and continue to be, located in town centres and potentially high risk urban areas.
Changes within town centres with regard to the type of retail and service premises, and their numbers.	Supermarkets have largely replaced traditional shops such as butchers and greengrocers. Planning policy, such as the decreasing availability of 'greenfield' sites and increasing availability of 'brownfield' sites, has forced companies to reconsider the town centre. Town centres and shopping centres are becoming more 'lifestyle' and leisure focused.
The high street has been entering a period of consolidation and change.	Changes in lifestyle have led to more requirements in towns for the leisure sector, including café society, pubs, and health and fitness centres, which have focused on the high street. Significant expansion by the mobile telephone and sports operators, and coffee shop operators.
Predictions for the future of town centres are for more mixed leisure, retail and residential uses.	Local authorities are aggressively promoting their town or city centres in order to generate inward investment. There is a drive to open up these centres to improve the environment, and extend the amount of time that customers spend there, by creating complementary leisure attractions.
Continued trend towards the leisure market.	Cinemas, restaurants and bars re-establishing themselves in town centres as well as on out-of-town retail parks. Cinema attendance has increased in recent years and in 2000 was at a 26-year high, with multiplexes estimated now to account for 70% of screens. Many former cinemas within the high street are now being converted for use as Bingo halls, for which demand is increasing.

Table 5.2 Continued	
The development of large out-of-town leisure parks that were common in the 1990s is not predicted to be repeated.	The land use planning system is likely to determine that most future leisure schemes are part of mixed-use developments that are likely to be in city centres or on the edge of towns. Companies who lease their premises report that more leases are being reduced to 15 years to facilitate mobility as shopping centre trends change.
Out-of-town retail	
Out of town retail parks now an accepted feature of most regional centres.	This has switched the emphasis from High Street shopping to retail parks with vast floor spaces and highly susceptible products at easy access to the customers. This 'big box' retailing is predicted to be the catalyst for many development schemes in the future, and larger centres and retail parks are predicted to dominate the landscape. Planning policies and pressure on land for development in urban areas suggests that new retail park schemes will be on the fringe of centres and in new urban villages.
The sale of non-food products (e.g. clothing, electrical and white goods) is rising rapidly in out of town locations.	Large supermarkets are putting increased emphasis on these products.
Retail services, such as fast-food restaurants, have been expanding.	These are often located within, or adjacent to, retail parks.
Growth of the retail warehouse market - now seen as a maturing sector.	Units on retail parks have shown particularly high growth rates. The current (2004/5) most preferred 'anchors' in retail parks are the fashion and DIY sectors, followed by furniture and food (supermarkets).
Demand from the technology, media and telecommunications sector has led to the expansion of the logistics industry.	Grocery retailers now offer on-line shopping from dedicated warehousing. Oxfordshire has been identified as a model for locations as part of the government's 'innovation centres' initiative.
Industrial sector	
The industrial and industrial warehouse property sector has been a top performer in recent years in terms of total investment returns.	Much of this performance has been, and is anticipated in the future to be, in the South East of England. One of the driving forces is predicted to be the continued demand from Internet Service Providers for tele-hotels, which provide an outsourcing service to major clients. This market is predominantly based within London for large units typically in excess of 4,500m^2, and in areas populated by fast growing service companies. Recent figures suggest that 10% of all new space in London has been leased by telecom companies, with a future figure of 25% predicted. Flood loss potential could be high for these companies.
Self-storage is one of the fastest growing sectors within the service industry.	Corporate activity and rapid growth in the technology, media and telecoms sector has created demand for 'hi-tech' and specialised storage space. The self-storage industry is currently highly fragmented, characterised by a large number of small players who often operate single centres. These operators have targeted the South East and London, where the majority of their centres are located.
Predicted polarisation of demand for industrial warehouses.	Occupiers in England are likely to focus largely on the Midlands and/or the South East for very large national distribution centres, with the North West and South West also benefiting from requirements for regional distribution centres. The M40 corridor is increasingly becoming recognised as a viable location for speculative development. It is predicted that demand levels for rental properties in the industrial telecom market will remain high, as well as in other service sectors, parcel delivery, and courier markets.
Sources: FPD Savills, 2004a; FDP Savills, 2004b; FPD Savills, 2001a,b; FPD Savills, 2000a,b,c; King Sturge, 2002; King Sturge, 2001a,b,c,d	

Table 5.3 MCM non-residential property landuse codes

MCM land use code	Category description	MCM land use code	Category description (cont.)	MCM land use code	Category description (cont.)
21	**Shop/Store**	**41**	**Distribution/Logistics**	**61**	**Public Building**
211	High Street Shop	410	Warehouse – general	610	School/University/ College
213	Super/Hypermarket	411	Electrical warehouse	620	Surgery/Health centre
214	Retail Warehouse	412	Non-frozen food ware-house	625	Residential Home
215	Showroom	413	Frozen food warehouse	630	Hall/community centre
216	Kiosk	420	Land used for storage	640	Library
217	Outdoor market	430	Road Haulage	650	Fire/Ambulance Station
218	Indoor market	**51**	**Leisure**	651	Police Station
22	**Vehicle Services**	511	Hotel	660	Hospital
221	Garage/vehicle repair	512	Boarding House	670	Museum
222	Filling Station	513	Caravan (moveable)	680	Law Court
223	Car Showroom	514	Caravan (fixed)	690	Church
224	Plant Hire	515	Self catering unit	**81**	**Industry**
23	**Retail Services**	516	Hostel	810	Workshop
231	Hairdresser	517	Bingo hall	820	Factory/Works/Mill
232	Betting Shop	518	Theatre/Cinema	830	Extractive/Heavy Industry
233	Launderette	519	Beach hut	840	Sewage Treatment works
234	Public House/Club	**52**	**Sport**	850	Laboratory
235	Restaurant	521	Playing fields/grounds	**91**	**Miscellaneous**
236	Café/Fast Food	522	Golf course	910	Car Park
237	Post Office	523	Sports/Leisure Centre	920	Public Conveniences
238	Garden Centre	524	Amusement park/arcade	930	Cemetery/Crematorium
31	**Office**	525	Football ground	940	Bus Station
310	Office (non specific)	526	Mooring/Wharf/Marina	950	Dock installation
311	‘Hi-Tech’ Office	527	Swimming Pool	960	Electricity installation
320	Bank/Building Society				

Table 5.4 The distribution of non-residential properties within Flood Zone 3: those with * represent NRPs for which depth/damage data is available on the MC CD in Appendices 5.5 and 5.6. Shaded areas indicate top 20 NRP sub-categories by frequency within the Zone.

Non Residential Properties in Flood Zone 3 (tidal + fluvial)			
MCM Code	**Category/ Description**	**No of NRPs**	**% within Zone 3**
21	**Shop/Store**	**47085**	**24.25**
211*	High Street Shop	43132	22.22
213*	Super/Hypermarket	261	0.13
214*	Retail Warehouse	1576	0.81
215	Showroom	1151	0.59
216	Kiosk	576	0.30
217	Outdoor market	No data	
218	Indoor market	389	0.20
22	**Vehicle Services**	**6773**	**3.48**
221*	Garage/vehicle repair	4859	2.50
222*	Filling Station	973	0.50
223*	Car Showroom	941	0.48
224*	Plant Hire	No data	
23	**Retail Services**	**14201**	**7.31**
231*	Hairdresser	1711	0.88
232	Betting Shop	542	0.28
233	Launderette	217	0.11
234*	Public House/Club	6554	3.38
235*	Restaurant	3014	1.55
236*	Café/Fast Food	1483	0.76
237	Post Office	680	0.35
238*	Garden Centre	No data	
31	**Office**	**36751**	**18.93**
310*	Office (non specific)	35443	18.26
311*	Hi-Tech Office	48	0.02
320*	Bank/Building Society	1260	0.65
41	**Distribution/Logistics**	**29661**	**15.28**
410*	Warehouse – general	26621	13.71
411 *	Electrical warehouse	No separate data	
412*	Non-frozen food warehouse	No separate data	
413*	Frozen food warehouse	No separate data	
420	Land used for storage	2861	1.47
430	Road Haulage	179	0.09
51	**Leisure**	**8361**	**4.31**
511*	Hotel	1185	0.61
512	Boarding House	1026	0.53
513/514*	Caravan sites	1296	*0.67*
515	Self catering unit	922	0.47
516	Hostel	495	0.25
517*	Bingo	78	0.04
518*	Theatre/Cinema	212	0.11
519*	Beach hut	3147	1.62

Non Residential Properties in Flood Zone 3 (tidal + fluvial) cont.			
MCM Code	**Category/ Description**	**No of NRPs**	**% within Zone 3**
52	**Sport**	**3494**	**2.00**
521	Playing fields/grounds	640	0.33
522	Golf course	108	0.06
523*	Sports/Leisure Centre	1649	0.85
524	Amusement park/arcade	233	0.12
525	Football ground	163	0.08
526	Mooring/Wharf/Marina	622	0.32
527	Swimming Pool	79	0.04
61	**Public Building**	**10150**	**5.23**
610*	School/ University/College	3239	1.67
620*	Surgery/Health centre	2350	1.21
625*	Residential Home	No data	
630*	Hall/community centre	3263	1.68
640*	Library	350	0.18
650*	Fire/Ambulance Station	230	0.12
651	Police Station	295	0.15
660	Hospital	130	0.07
670	Museum	214	0.11
680	Law Court	79	0.04
690	Church	No data	
81	**Industry**	**34638**	**18.00**
810*	Workshop	26875	13.84
820	Factory/Works/Mill	6870	3.54
830	Extractive/ Heavy Industry	461	0.24
840	Sewage Treatment	432	0.22
850*	Laboratory	No data	
91	**Miscellaneous**	**3024**	**1.56**
910	Car Park	1975	1.02
920	Public Conveniences	737	0.38
930	Cemetery/Crematorium	133	0.07
940	Bus Station	80	0.04
950	Dock installation	45	0.02
960	Electricity installation	54	0.03

NB: Where data is sparse (e.g. MCM codes 81 to 850) site specific surveys of the relevant properties may be needed (see Section 5.8.3)

Table 5.5 Flood damage components for retail code 211 (High Street Shops) – From MC CD Appendix 5.4 Table 1

Flood Damage Components for Retail Code 211 (High Street shops)	
High Street shops: included here are fashion and clothing stores; shoes, and sports goods retailers; electrical goods suppliers; video rentals, mobile telephone shops; those selling cosmetics, pharmaceuticals and toiletries; general household goods, hardware and soft furnishings; bookstores and stationers; wine merchants.	
Services (in addition to basic):	**Moveable Equipment:**
Generators	Racking e.g. for clothing, books
Sprinkler pumps and equipment	Storage units
Lifts	Counters
Escalators (not typical)	Computers
Electric shutters/gates	Photocopiers
Overhead door heaters	Tills (mostly computerised)
Satellite systems	Furniture (tables, chairs, sofas, desks)
Mobile telephone boosters	Display tables
Aerials	Display equipment/gondolas
Hydraulic tubes (for cash transfers)	Baskets and stands
	Pallet trucks
	Ladders
	Forklifts
	Packing machinery
	Delivery vehicles
	Tagging equipment
Fixtures and Fittings	**Stock**
Freezers and/or chiller cabinets and refrigeration equipment	Clothing
Shelving and racking	Shoes
Counters/service desks	Clothing accessories
Display equipment/gondolas	Toiletries
Seating	Cosmetics
Signage	Pharmaceutical products
Carpets and floor covering	Stationary
Wall coverings	Books/magazines/greetings cards
Cupboards/cabinets	Household goods and soft furnishings
Partitioning	Electrical goods and equipment
Suspended ceilings	DVDs/videos/MCM CDs/cassettes/computer games
Plasma screens	Mobile telephones and accessories
Light fittings	Office furniture and accessories
Safes	Fresh foodstuffs, dry groceries, confectionery
Sanitary fittings (toilets, basins)	Wine, spirits, beer, soft drinks
	Toys
	DIY home improvement materials and goods
	Tools
	Furniture (including garden furniture)
	Bathroom/kitchen fittings
	Lighting
	Bicycles and vehicle components
	Indoor and garden plants, gardening equipment

Table 5.6 Uplift factors for damages from longer duration flooding (≥ 12 hours)

Depth (metres)	Factor
3.00	1.17
2.75	1.17
2.50	1.17
2.25	1.17
2.00	1.18
1.75	1.18
1.50	1.19
1.25	1.20
1.00	1.22
0.75	1.26
0.50	1.30
0.25	1.32
0.00	1.00
-0.25	1.00
-0.50	1.00
-0.75	1.00
-1.00	1.00
Average from above	1.15

Table 5.7 Possible extra damage from coastal (saltwater) flooding

Saltwater corrosion (e.g. of steel piping and conduits)
Wave and spray damage
Possible scouring around building structure by water action
Damage to metal parts due to oxidation
Damage to building fabric and woodwork from penetration of salts
Damage to electrical wiring due to electrochemical action in the presence of saltwater
Pitting to plaster and other boards
Damage to paintwork due to salt being trapped between layers.
Discolouration of internal decoration
Damage to metallic finishes
Damage to furniture and soft furnishings due to staining from salts
Clean-up can be more costly due to salt content
Increased loss of production (indirect losses) while plant is repaired or replaced

Table 5.8 Uplift factors for damages from coastal flooding

Depth (metres)	Factor
3.00	1.15
2.75	1.16
2.50	1.16
2.25	1.17
2.00	1.17
1.75	1.19
1.50	1.19
1.25	1.21
1.00	1.23
0.75	1.29
0.50	1.33
0.25	1.41
0.00	1.17
-0.25	1.22
-0.50	1.18
-0.75	1.20
-1.00	1.29
Average from above	1.22

Table 5.9 Potential loss reduction upon receipt of a flood warning (lead-time ≥4 hours): moveable equipment and stock

Depth (metres)	Percentage potential loss reduction with warning ≥ 4hours	
	Moveable equipment (%)	Stock
3.00	40	38
2.75	40	39
2.50	41	39
2.25	42	40
2.00	43	40
1.75	43	41
1.50	43	42
1.25	44	42
1.00	45	43
0.75	45	44
0.50	45	42
0.25	44	36
0.00	43	38
-0.25	43	53
-0.50	43	54
-0.75	43	54
-1.00	43	53
Average from above	43	43

Table 5.10 Factors likely to impact upon the effectiveness of flood warnings

Warnings are likely to be more effective in reducing flood losses for NRPs when:
They have a long lead-time (preferably at least eight hours)
People have confidence in the warning and the issuing authority
They give specific information on the timing and likely level of flooding
Staff are aware of what actions to take
There are enough able-bodied staff or contractors available to move equipment and goods and take mitigating actions
Equipment and goods are able to be moved (e.g. not too large or too heavy)
There is space on upper floors or storage areas, in an alternative location, or on higher ground to which to move equipment and goods
Appropriate refrigeration is available for storing perishable foodstuffs, drinks, pharmaceuticals etc. elsewhere
Surrounding areas and roads are not flooded or disrupted by flooding

Table 5.11 Weighted annual average damage by standard of protection

Standard of Protection (years)	Factory Bulk Class (£/m^2)	Retail Bulk Class (£/m^2)	Warehouse Bulk Class (£/m^2)	Office/other Bulk Class (£/m^2)
None	50.40	77.50	147.40	161.80
2	40.60	60.70	118.30	122.00
3	36.23	53.27	105.37	104.77
4	31.87	45.83	92.43	87.53
5	27.50	38.40	79.50	70.30
6	25.16	34.84	72.34	64.74
7	22.82	31.28	65.18	59.18
8	20.48	27.72	58.02	53.62
9	18.14	24.16	50.86	48.06
10	15.80	20.60	43.70	42.50
15	13.17	17.03	36.17	35.20
20	10.53	13.47	28.63	27.90
25	7.90	9.90	21.10	20.60
30	7.04	8.82	18.78	18.34
35	6.18	7.74	16.46	16.08
40	5.32	6.66	14.14	13.82
45	4.46	5.58	11.82	11.56
50	3.60	4.50	9.50	9.30
55	3.33	4.16	8.79	8.60
60	3.06	3.82	8.08	7.90
65	2.79	3.48	7.37	7.20
70	2.52	3.14	6.66	6.50
75	2.25	2.80	5.95	5.80
80	1.98	2.46	5.24	5.10
85	1.71	2.12	4.53	4.40
90	1.44	1.78	3.82	3.70
95	1.17	1.44	3.11	3.00
100	0.90	1.10	2.40	2.30
200	0.45	0.55	1.20	1.15

Table 5.12 Mean floor area (m^2) by sub-category of Non Residential Property - September 2004 (Valuation Office Agency Pers. Comm. from amalgamation of ODPM Bulk Class statistics)

Bulk Class	Focus Code	MCM Code	Description	Mean (m^2)
Retail	CG3	223	Car showroom	1256.03
	CL1	234	Wine bar	177.19
	CL2	234	Club (social)	501.41
	CR	235	Restaurant	193.01
	CR1	236	Café	96.09
	CR2	236	Food Court	240.15
	CS	211	Shop	145.50
	CS1	320	Bank	297.20
	CS10	232	Betting shop	88.33
	CS2	231	Hairdressing salon	54.28
	CS3	216	Kiosk	16.59
	CS4	233	Laundrette	75.71
	CS5	237	Post Office	146.47
	CS6	215	Showroom	456.25
	CS7	213	Hypermarket	9947.59
	CS8	213	Superstore	5259.54
	CS9	214	Retail warehouse	1859.89
	LT1	524	Amusement arcade	348.34
Warehouse	CG4	430	Road haulage	2369.08
	CW	410	Warehouse	1222.24
	CW1	420	Storage land	1628.93
	CW2	410	Storage depot	1319.35
	CW3	410	Store	169.96
Office	CO	310	Office	292.53
	ML	310	Office (Local Government)	1347.79
	MP	651	Police station	854.22
	CO1	311	Hi tech (computer centre)	3500.66
	MH	620	Surgery	150.89
	MH1	620	Health centre	368.37
Factory	CG1	221	Vehicle repair	300.86
	CG2	221	Garage	267.76
	IF	820	Factory	2867.01
	IF1	820	Mill	5973.29
	IF2	820	Works	4732.60
	IF3	810	Workshop	312.31
	IF4	310	Business unit	111.34
	MS1	650	Fire station	329.59
	MS2	650	Ambulance station	404.70

Table 5.13 Mean floor areas for Bulk Classes (ODPM, 2004)

Bulk Class	Mean ground floor area (m^2)
Retail	198
Warehouse	755
Factory	865
Office	307
All bulk	442

Table 5.14 Possible indirect losses affecting NRP properties (not all economic losses)

Lost income/trade/profit
Disruption costs
Deferred trade/production
Additional clean-up costs
Inspection costs
Transferral of operations to another site
Rental of alternative premises
Costs of additional working site(s)
Transportation costs
Cold storage or refrigeration costs
Temporary staff costs, including overtime, incentive payments, retainer fees (for highly skilled staff)
Costs from sub-contracting out work
Temporary repair costs

Table 5.15 A guide on when to assess indirect NRP losses

NRP sector, category and sub-category	Recommendation
NRP sector or individual properties	If the NRP sector contributes more than 30% of total direct damages, or an individual property contributes more than 10% of total direct damages, then a site survey will be necessary as indirect losses may be significant.
Retail [codes starting with 2]	Ignore indirects unless customers have to make a substantial journey to other similar shops and thereby incur significant travel costs – if so see Chapter 6 for traffic disruption and transport costs
Office [codes starting with 3]	Ignore indirects. They are only likely to be significant in a few cases (e.g. in the case of call centres where business could be lost overseas). Many large firms now have business interruption plans in place to avoid this situation.
Factory/warehouse/workshop [codes starting with 4 or 8]	Ignore indirects unless there is information to suggest that buildings are highly specialised in a concentrated sector.
Leisure and Sport [codes starting with 5]	Ignore indirects
Public sector [codes starting with 6]	Ignore indirects
Miscellaneous [codes starting with 9]	Ignore indirects

Table 6.1 Enumeration, descriptors and valuation measures to gauge the scale of infrastructural risk

Infra-structure type	Enumeration/ descriptor	Valuation measures	Susceptibility	Dependency	Transferability/ redundancy
Roads	Length (km) of M,A,B minor within IFP; flood thresholds	User numbers (cars, HGV, LGV, PSV) Flood free alternative routes	High/Medium or Low	High/Medium or Low	High/Medium or Low
Railways	Length (km) of Inter City, Regional, local, commuter; flood thresholds	No. passengers; trains per day, alternative routes	High/Medium or Low	High/Medium or Low	High/Medium or Low
Electricity Transmission	KV, lengths, threshold of flooding of plinth	Supply catchment, population served	High/Medium or Low	High/Medium or Low	High/Medium or Low
Electricity sub-stations, switching stations	Size, threshold of flooding	Supply catchment, population served	High/Medium or Low	High/Medium or Low	High/Medium or Low
Gas pressure pumping stations (1)	Type and number	Supply catchment, population served	High/Medium or Low	High/Medium or Low	High/Medium or Low
Water Treatment Plant (1)	Type and number (pumping station, booster station etc.), threshold of flooding	Supply catchment, population served	High/Medium or Low	High/Medium or Low	High/Medium or Low
Sewage treatment plant (1)	Type and number (Biological filter, Activated sludge, pumping station etc.), threshold of flooding	Drainage catchment, population served	High/Medium or Low	High/Medium or Low	High/Medium or Low
Telecommunications(2)	Exchanges, cabinets, pillars, threshold of flooding	Population served	High/Medium or Low	High/Medium or Low	High/Medium or Low

(1) Water distribution and supply mains, trunk sewers and gas lines can be ignored unless likelihood of fracture is high (e.g. on exposed river crossings)

(2) Redundancy is now high with universal application of mobile telephony. Telecommunications losses and disruption can all but be ignored unless physical damage is likely with high probability within an exchange

Table 6.2 Total risk scale

IMPACT	*High*	Medium Risk	High Risk	Very High Risk
	Medium	Low Risk	Medium Risk	High Risk
	Low	Negligible Risk	Low Risk	Medium Risk
		Low	*Medium*	*High*
		LIKELIHOOD		

Table 6.3 'First cut' trawl of impacts for utility/infrastructure components

Utility/Infrastructure	Susceptibility	Dependency	Transferability/ redundancy	Scale 1=few 2=many	Total Impact
Electricity transmission					
>132 kV (fluvial)	Low	High	Low	1 and 2	Low
> 132 kV (tidal) [1]	High	High	Low	1 and 2	High
< 132 kV (fluvial)	Low	Medium	Low	1 and 2	Low
< 132 kV (tidal)	High	Medium	Low	1 and 2	Med
Sub-stations /switching gear	Medium	High	Medium	1	Low
Sub-stations /switching gear	Medium	High	Medium	2	Med
Gas transmission					
Gas pressure stations	Medium	Medium	Low	1	Low
Gas pressure stations	Medium	Medium	Low	2	Med
Water and waste water treatment					
Waste water treatment plant	High	High [2]	Low	1	Med
Waste water treatment plant/pumping stations	High	High [2]	Low	2	High
Water treatment plant	Medium	High	Medium [3]	1	Med
Water treatment plant	Medium	High	Medium [3]	2	High
Water pump stations	High	High	Low	1 & 2	Med
Telecommunications					
Connection points – cabinets	Low	Medium	High	2	Low
Telecoms connection points – pillars	Low	Medium	High	1	Low [4]

[1] Transmission lines across a coastal floodplain are likely to collapse during "Do Nothing" tidal inundation
[2] Environmental damage through treatment bypass might be as important as physical damage
[3] Depends on locality
[4] Redundancy of landline facilities is extremely high with saturation coverage of mobile telephones (masts are rarely in flood plains)

Table 6.4 The first step in 'filtering' process for infrastructural impacts in the Caldicot levels, South Wales

Infrastructure type	Enumeration/ descriptor	Valuation measures	Susceptibility	Dependency	Transferability/ redundancy
M4 Motorway and Toll plaza	6km of M4 Motorway with toll plaza dipping to 7.2 m (below spring tide level)	45,000 vehicles use the Second Severn (road) Crossing each day. Alternative route via M48 (Severn bridge) or even Gloucester	High	High	Medium
Intercity (GWR) Paddington to South Wales Railway, Midlands regional railway (Alphaline) and EWS freight	29km of track with lowest level of network at 7.7m with "Do Nothing" flood frequency 5 times per year	1,187 passenger services each week and 147 freight services. No alternative routes by train	High	High	Low
Electricity transmission: high, medium and low voltage transmission lines; sub-stations and switching gear	In excess of 50km of power lines supported on pylons with concrete plinths at levels AOD some 2-3 metres below spring tide level. Whitsun and Uskmouth sub-stations	275KV and 400KV lines transmitting 2/3rds of all South Wales' electricity from Iron Acton and Melksham	High	High	Low
Sewerage and sewage treat-ment	Nash Sewage treatment works; Orb Pumping Station and Chep-stow to Nash Trunk sewer. Inlet works below spring tide level	Newport and all settlements east of River Wye. Serious pollution of coastal waters	High	High	Low

Table 6.5 Total costs of travel as a function of speed (pence/km)

	Speed (km/hr)									
	1	2	5	10	20	40	50	80	100	150
Car average p/km	1010	506	205	104	54	29	24	16	14	11
LGV average p/km	966	486	197	101	53	29	24	17	14	12
OGV1 p/km	937	474	195	103	56	33	28	21	19	16
OGV2 p/km	1086	549	226	119	65	38	32	25	21	19
PSV p/km	7046	3533	1426	723	371	196	161	107	90	68

Source: based on DTLR (2000) (updated to 2005 figures)

Table 6.6 Annual average loss calculation assuming flooding five times per annum (updated to 2005)

t_{pot}	t_{am}	Loss (£)	Monthly exceed-ance probability	Interval Benefit (£)
0.2	1.01	0	0.417	
0.25	1.02	2534	0.333	106
0.5	1.16	3801	0.167	526
1	1.58	5068	0.083	372
1.4	1.96	6335	0.060	131
2	2.54	7602	0.042	125
5	5.52	8869	0.017	206
20	20.50	10136	0.004	124
50	50.50	15203	0.002	25
			monthly benefits	1616
			annual benefits	19392

Table 6.7 Data requirements

Data	Source
Traffic flows	Highway Authority
Traffic mix	Highway Authority
Resource costs and values of time	HEN (Dept. Transport)
Road levels	GPS based drive through survey
Flood durations	Hydraulic model

Table 6.8 Speed-flow relations

Road type	Free Flow speed (kph)	Free Flow limit (pcu/h/lane)	Limiting capacity (pcu/h/lane)	Speed at Limiting Capacity (kph)
	VC	QC	QM	VM
	Free flow speed	Speed falls linearly over this range		
Rural motorway	90	1800	2600	76
Rural dual carriageway	79	1600	2400	70
Rural all purpose road	70	400	1800	57
Rural all purpose road – poorly aligned	50		600	50
Urban motorway	80	1700	1400	66
Urban dual carriageway				
With limited access and 80 kph limit	65	1400	220	56
65 kph speed limit	50	600	1100	30
Urban single carriageway road				
outer area	45	500	1000	25
intermediate area	35	350	600	25
central business area	25	250	500	15
Suburban – major radial or outer ringroads				
No major intersections	**Speed limit**	2000	47	
< 1 major intersection per km		1700	27	
1-2 major intersection per km		1200	20	
Source: Department of Transport 1981				

Table 6.9 Percentage delay/cancel due to flooding

Rail service	Delay %	Cancel %
Regional	40	60
Intercity	40	60
Commuter	40	60
Freight	45	55
Source: Posford Duvivier (1999)		

Table 6.10 "Do Nothing" return periods of track levels within the Caldicot Levels

Location	Floodplain sub-area	Height (m AODN)	Return period of the flood at that height
South of industrial estate	Newhouse Farm	7.7	<0.2 years (<5%)
West of Mathern Pill	St Pierre	8.23	1-2 years (0.66%)
Road bridge south of Magor square	Caldicot main	7.13	<0.2 years (<5%)
Rogiet road bridge	Caldicot main	8.44	5-10 years (0.13%)
Undy	Caldicot main	9.06	500-1000 years (0.0013%)

Table 6.11 Potential damage to rail track and equipment at the Caldicot Levels with flooding at each location (see Figure 6.1).

Floodplain sub-area	Damage costs to embankment/track	Damage to signalling etc.
Newhouse Farm	£ 200,000	£ 1,000,000
St Pierre	£ 100,000	£ 500,000
Caldicot main	£ 200,000	£1,000,000

Table 6.12 Principal costs for North Yorkshire County Council

A	Gross Revenue Costs	£1,845,000
B	Disqualified Costs (by auditor)	£6,000
C	Combined District Bellwin threshold	£129,000
D	Revenue costs incurred but not eligible through Bellwin	£119,000
E	Expected Bellwin Payment (i.e. A-B-C-D)	£1,591,000

Table 6.13 Summary of NYCC, Police and Fire service emergency costs

Authority	Cost	% of total
North Yorkshire County Council	£1.845 million	39.34
(NYCC Bellwin claim)	(£1.733 million)	(36.95)
Fire Service	£0.414 million	8.83
North Yorkshire Police Authority	£0.681 million	14.52
District Council*	£0.750 million	15.99
York City Unitary Authority*	£1.000 million	21.32
Total	£4.690 million	

*District Council and York City costs remain estimated, with Selby accounting for half the District Council costs. Most of District Council costs relate to staff overtime, particularly filling sandbags.

Table 6.14 North Yorkshire County Council, Fire Service and Police Authority Costs associated with Autumn 2000 floods

Category	North Yorkshire County Council, Fire and Police Service spend in each District Council																	
	Selby		Ryedale		Harrogate		Hambleton		Craven		Richmondshire		Scarborough		York		Total	
	£	No. of cases	£	No. of cases	£	No. of cases	£	No. of cases	£	No. of cases	£	No. of cases	£	No. of cases	£ No. of cases		£	No. of cases
Care Related Services																		
Nursing Home Evacuation	101,790	5					2,657	2							not available		104,447	7
Total	**101,790**	**5**					**2,657**	**2**									**104,447**	**7**
Flood Alleviation																		
Sandbagging	471,379		15,917		53,508		48,715		58,537		35,045		30,465		not available		713,566	
Emergency costs	28,072		21,604		174,000		50,617		5,866		20,344		19,140		not available		319,643	
Total	**499,451**		**37,521**		**227,508**		**99,332**		**64,403**		**55,389**		**49,605**				**1,033,209**	
Highways and Bridges																		
Emergency repairs-Roads	1,877	1	58,959	19	111,381	9	37,922	18	45,626	12	18,434	12	126,891	17	not available		401,090	87
Emergency repairs-Bridges	5,809	2	2,287	1	62,761	7	20,268	4	57,849	3	21,157	6	940	1	not available		171,071	22
Total	**7,686**	**3**	**61,246**	**20**	**174,142**	**16**	**58,190**	**22**	**103,475**	**15**	**39,591**	**18**	**127,831**	**18**			**572,161**	**109**
Emergency Planning																		
Evacuation	12,700																	
Total	**12,700**																**12,700**	
Education Related																		
Evacuation-Sherburn school	10,015	1																
Total	**10,015**	**1**															**10,015**	**1**
Total North Yorkshire CC	**631,642**	**9**	**98,767**	**20**	**401,650**	**16**	**160,179**	**24**	**167,878**	**15**	**94,980**	**18**	**177,436**	**18**	**0**	**0**	**1,732,532**	**117**

	£	%	£	%	£	%	£	%	£	%	£	%	£	%	£	%	£	%
Fire Services																		
Overtime/additional staff	102,479	72	23,164	72	24,355	72	27,808	72	13,512	72	11,169	72	16,457	72	77,510	72	296,454	72
Travel/Subsistence	1,194	1	270	1	284	1	324	1	157	1	130	1	192	1	903	1	3,454	1
Supplies	15,818	11	3,580	11	3,764	11	4,298	11	2,088	11	1,726	11	2,544	11	11,980	11	45,798	11
Premises/Telecommunications	1,310	1	296	1	311	1	356	1	173	1	143	1	211	1	990	1	3,790	1
Transport	22,324	16	5,046	16	5,305	16	6,057	16	2,943	16	2,433	16	3,585	16	16,885	16	64,578	16
Fire Service Total	**143,125**	**34.6**	**32,356**	**7.8**	**34,019**	**8.2**	**38,843**	**9.4**	**18,873**	**4.6**	**15,601**	**3.8**	**22,989**	**5.6**	**108,268**	**26.1**	**414,074**	**100.0**
North Yorkshire Police																		
Overtime Police	263,844	80.4	100,648	90.0	1,224	68.5	15,317	91.9	500	92.3	892	91.2	4,713	91.8	179,723	83.1	566,861	83.2
Overtime Support	2,077	0.6	1,193	1.1		0.0		0.0		0.0		0.0		0.0	5,059	2.3	8,329	1.2
Mutual Aid (Other forces)	34,073	10.4		0.0		0.0		0.0		0.0		0.0		0.0	631	0.3	34,704	5.1
Travel, Subsistence, Accomm.	0	0.0	271	0.2		0.0		0.0		0.0	10	1.0		0.0	1,039	0.5	1,320	0.2
Vehicle Costs	750	0.2	7	0.0	400	22.4	46	0.3		0.0		0.0	20	0.4	1,576	0.7	2,799	0.4
Other Costs	1,835	0.6	979	0.9	25	1.4		0.0		0.0		0.0		0.0	11,541	5.3	14,380	2.1
Command/Authority Wide	25,523	7.8	8,696	7.8	139	7.8	1,296	7.8	42	7.7	76	7.8	399	7.8	16,834	7.8	53,005	7.8
Police Authority Total	**328,102**	**48.2**	**111,794**	**16.4**	**1,788**	**0.3**	**16,659**	**2.4**	**542**	**0.1**	**978**	**0.1**	**5,132**	**0.8**	**216,403**	**31.8**	**681,398**	**100.0**
Grand Total	**1,102,869**	**39.0**	**242,917**	**8.6**	**437,457**	**15.5**	**215,681**	**7.6**	**187,293**	**6.6**	**111,559**	**3.9**	**205,557**	**7.3**	**324,671**	**11.5**	**2,828,004**	**100.0**

Notes:
Where number of cases i.e. incidents is quoted these are the most significant separately identified incidents
York is a Unitary Authority and North Yorkshire's costs do not here apply
All the North Yorkshire CC costs reflect the local assistance to the District Councils. District Council actual costs are not included
The North Yorkshire costs are the allowable Bellwin cost: a further £119,000 was not eligible through Bellwin and the auditors dismissed a further £6,000

Table 6.15 Environment Agency emergency repair and response costs

Flood Defence Committee/Region £'000s	Original budget 00/01	1% ceiling	Total emergency repairs (note 2)	Total emergency Response (note 2)	Down payment allocation (note 1)	Balance due (- repayable)
North West	26,576	266	380	110	0	224
Northumbria	4,158	42	195	131	406	-122
Yorkshire	25,248	252	3,942	2,432	4,009	2,113
Midlands	30,658	307	1,750	786	968	1,261
Southern Region						
Hants & Isle of Wight	3,472	35	159	106	181	49
Kent	13,096	131	1,106	741	869	847
Sussex	11,214	112	401	838	851	276
Southwest	8,612	86	374	134	280	142
Avon & Dorset	5,043	50	276	187	163	250
Bristol Avon	3,323	33	163	55	78	107
Somerset	5,700	57	340	552	317	518
Thames	70,300	703	1,167	2,095	878	1,681
Head Office	0	0	-	10	0	10
SUB TOTAL	**207,400**	**2,074**	**10,253**	**8,177**	**9,000**	**7,356**
Anglian Region						
Essex	10,590	106	2	60	0	0
Great Ouse	11,232	112	25	75	0	0
Lincoln	13,588	136	-	90	0	0
Norfolk/Suffolk	16,063	161	-	10	0	0
Well & Nene	7,479	75	12	30	0	0
TOTAL ENGLAND	**266,352**	**2,664**	**10,292**	**8,442**	**9,000**	**7,356**

Note 1. Provisional allocation by Head Office Finance pending confirmation of final out-turn
Note 2. Includes emergency repair and response costs for 2000/01 and 2001/02

Table 6.16 Environment Agency: Additional costs

Region £000's	External						Sub Total	Internal	Total Costs	Out-turn 31.3.2001	Estimated carry over
	A	B	C	D	E	F					
North East	0	444	148	138	23	36.3	789.3	267	1,056.3	0	300
Midlands	0	33	45	5	0	40.8	123.8	80	203.8	150	0
Southern	0	24	56	0	129	28.2	237.2	73	310.2	0	0
Anglian	0	0	5	0	0	46.5	51.5	0	51.5	52	0
Thames	0	79	37	40	57	74.4	287.4	102	389.4	731	0
South West	39	95	10	0	0	24.3	168.3	24	192.3	41	100
North West	0	3	0	2	9	33.6	47.6	55	102.6	103	0
Wales					46.8	15.9	62.7		62.7	0	0
Total	**39**	**678**	**301**	**185**	**264.8**	**300**	**1,767.8**	**601**	**2,368.8**	**1,077.0**	**400.0**

A = Photogrammetry & LIDAR
B = Ground Surveys
C = Aerial Photographs
D = Condition Surveys
E = Flood Report lessons learnt (estimated internal costs allocation to flood report £100k)
F = Extra Flood Line call costs (memo dated 23.11.2000 from Manoch Kerman)
All the above attract extra statutory contribution of 100% subject to a ceiling of £2.5m
Note: costs which could be classed as pre-feasibility should be included in this schedule

Table 6.17 Overall emergency costs as applicable to project appraisals

A. Autumn 2000 total losses*		
	Financial £ millions	Economic £ millions
Property losses	946	570
Professional Partners	39	39
Capital Grants to PP	58	58
Environment Agency	21	21
Road Traffic Disruption	73	13
Railway Network	51	51
Agriculture	195	35
TOTAL (£ millions)	**1383**	**787**

B. North Yorks CC emergency cost (Bellwin) breakdown			
Cost item	% of total	Allowed** amount (%)	% of total allowed
Sandbagging	41	0	0
Roads/bridges	33	50	16.5
Education	1	100	1
Emergency planning	1	100	1
Care related	6	100	6
Flood emergency	18	100	18
TOTAL	**100**		**42.5**

C. Emergency costs applicable to project appraisals			
Cost item	Amount	Allowed** amount (%)	Allowed amount
Total Bellwin:			
England	£28.3	42.5	£12.0
Wales	£7.6	42.5	£3.2
Costs below thresholds++	£3.1	42.5	£1.3
Severe Weather payments:			
England	£41.9	50.0	£21.0
Wales	£17.1	50.0	£8.6
Environment Agency costs+:			
Emergency repairs***	£11.1	50.0	£5.5
Emergency response	£9.2	100.0	£9.2
TOTAL	**£118.3**		**£60.8**

As % of economic property losses of £570m =	10.7%

* From Penning-Rowsell *et al*. (2002)
** Judged to be proper economic costs, not counted elsewhere in benefit-cost analyses. The figure for roads recognises some betterment after repair (hence the 50% taken)
*** As for roads, above, some element of betterment here, hence 50% taken.
\+ England and Wales
++ Taken as 50% of thresholds.

Table 7.1 Basic data for a hypothetical project to delay coastal erosion

Property	*Value (£)*	**Mean year lost**
House A	80,000	4
House B	60,000	7
3 mobile homes	3,000	10
Public house	240,000	13
House C	120,000	16
House D	90,000	17

Table 7.2 A best estimate of the probability that house A will loose in any given year

Year	0	1	2	3	4	5	6
Probability	0.05	0.10	0.15	0.20	0.35	0.10	0.05

Table 7.3 Residential property prices by region

	Housing land price (£/ha) Jan 2005 (For bulk land greater than 2ha) (1)	Average new dwelling price (£) 2005 1st quarter (2)	Average (all) dwelling price (£) 2005 1st quarter (2)
North East	2,210,000	162,766	131,979
North West	2,520,000	195,979	146,895
Yorkshire and The Humber	2,320,000	172,536	142,516
East Midlands	2,010,000	195,250	162,258
West Midlands	2,120,000	192,071	164,602
East	3,425,000	240,786	208,824
London	*6,895,000	307,253	273,402
South East	2,960,000	279,641	240,066
South West	2,200,000	225,990	209,076
Wales	2,180,000	189,030	146,333
England		225,320	198,752
Scotland	1,680,000	169,857	124,494
Northern Ireland	1,675,000	141,380	122,655

* average of Inner London (£7,800,000/ha) and outer London (£5,990,000/ha)

Notes:
(1) VOA publications, Property Market Report, www.voa.gov.uk/publications/property_market_report/pmr-jan-2005/residential.htm
(2) ODPM publication: Table 504 Housing market: simple average house prices www.odpm.gov.uk/stellent/groups/odpm_housing/documents/page/odpm_house_604091.xls

Table 7.4 UK residential property prices by dwelling type

Dwelling type	Price (£) in 2005 1st quarter (1)	% of average for all dwelling
Bungalow	193,006	102%
Detached	287,110	151%
Semi-detached	170,947	90%
Terrace	145,854	77%
Flat or Maisonette	153,143	81%
All dwellings	190,012	100%

Notes:
(1) ODPM Survey of Mortgage Lenders www.odpm.gov.uk/stellent/groups/odpm_housing/documents/page/odpm_house_029003.xls

Table 8.1 Sources and methods of information on recreation users/beneficiaries

Source/ method	Comments
1. Long period counts using people counters	Infra-red or other counters installed over a period (at least March to September). Counters are manually calibrated to relate passages to adult visits. Mainly applied in feasibility studies: in conjunction with a CV survey (See Section 8.5.3).
2. Short period manual counts/ surveys	Manual counts/surveys over a period of days normally including the August Bank holiday. At pre-feasibility stage, this method might be combined with site visits, and at feasibility stage, with the CV survey.
3. CV survey data	CV survey data on the frequency of visiting by local residents in conjunction with census data on the number of adult residents and staying visitors (in conjunction with managers' estimates of occupancy rates) can be used to generate visit number estimates. However, the tendency of survey respondents to overstate their visiting frequency has to be noted (See the Corton case study: section 8.7).
4. Old survey/ count data for the project	Planning, tourism or recreation departments of local authorities or local colleges or schools may have undertaken surveys or counts at the project site in the past, which can be updated to indicate current levels of use.
5. Inferred estimate	The number of visits to a coastal or river site is inferred from counts of visits to a related site nearby such as: Car and coach parks multiplied by the average adult car or coach occupancy rate (Hengistbury Head), funfair, cafe, visitor centre, historic site or museum (Hurst Spit and Hurst Spit castle). This requires estimating the proportion of all visitors to the project site who also use the counted site and vice versa. At feasibility level, this can be done in conjunction with the CV survey.
6. Visitor equations	A number of equations have been developed which predict distance-frequency functions so that from census data on the population in different zones a prediction can be made as to the number of visitors generated by the site.
7. Estimates from an informed persons or source	Written, telephone or personal contacts with: Car park attendants, park rangers/wardens, visitor centre staff, staff at associated visitor attractions, local authority tourism, sport and recreation or planning staff, regional or local offices of organisations such as the English Tourist Board, National Trust or English Heritage and their Welsh equivalents, the Environment Agency's recreation and fisheries staff, managers of general recreation or staying visitor facilities or tourism business organisations that may have information on bedspaces and occupancy rates (see the Corton case study, Section 8.7); both commercial and club managers of specialist facilities (e.g. sailing, boating/sailboarding, fishing, birdwatching) and specialist organisations at national regional and local level for information on the availability of alternative sites e.g. for caravans or sailing.
8. Average number of visits to equivalent sites	This benefit transfer approach is only suitable for pre-feasibility and strategic studies. The number of adult visits to the project site is estimated as being of the same order as the number of visits made to an equivalent site. However, there are few sites for which good data are available and little research to enable reliable identification of an equivalent site.

Table 8.2 Examples of visit numbers used for benefit assessment purposes

Site*		Annual visit numbers	
Name	**Characteristics**	**High estimate**	**Low estimate**
Undeveloped coastal sites			
Hengistbury Head, Christchurch, Dorset	Natural headland, a SSSI, with nature, geology and archaeology sites	609,000	584,000
Hurst Spit, Hampshire	Undeveloped shingle spit with heritage site, Hurst Castle	107,000	88,0000
Developed coastal sites			
St Mildred's Bay, Westgate, Kent	Small resort with promenade and sandy beach	212,000	-
Cliftonville, near Margate Kent	Small resort with clifftops and a mainly sandy beach	146,000	136,000
Corton, near Lowestoft, Suffolk	Small village resort with cliffs and partly sandy beach	97,000	75,000
River sites			
Local park	Park drawing visitors from 800m radius with no special attractions	30,000	60,000
'Honey pot' site, country park	Site drawing visitors from a 3 km radius	60,000	250,000

* At all these sites, both coastal and fluvial, almost all the visits involved informal use of the site for activities such as sitting, sunbathing and picnicking, strolling, dog walking, and, at coasts, playing informal games, playing in the sand and swimming or paddling. Very few visits involved specialist uses such as angling or boating or sailboarding.

Table 8.3 Method for estimating the number of informal riverside visits

Site	Number of adults resident in catchment	Number of adult visits per year
Local park	Number of adults within 500 - 800m radius of site	High: 27.6 Medium: 21.3 Low: 15.1
'Honey pot' site, country park	Number of adults within 3 km radius of site	Medium: 17

Table 8.4 Evaluating the effect of assumptions upon the overall benefit-cost ratio (shaded cells indicate where the benefit-cost ratio would lie under each of the assumptions for each case)

	Assumptions about the components of recreation values			
Benefit-cost ratios (including recreation benefits)	**A Low VOE/WTP and low visit numbers /beneficiaries**	**B Low VOE/WTP and high visit numbers /beneficiaries**	**C High VOE/WTP and low visit numbers /beneficiaries**	**D High VOE/WTP and high visit numbers /beneficiaries**
Case 1				
> 3.00				
c. 1.00				
< 0.30				
Case 2				
> 3.00				
c. 1.00				
< 0.30				
Case 3				
> 3.00				
c. 1.00				
< 0.30				

Table 8.5 £ Value of enjoyment of today's visit/a visit in current conditions for coastal sites

Site	Survey year	Sample size	Sample type	% able to value	£ mean value of enjoyment of today's visit - updated to March 2005(9)	£ mean value of enjoyment - at survey date
Undeveloped sites						
Hurst Spit (1)	1991	550	Site visitor	79%	£10.33	£7.37
Hengistbury Head (3)	1996	625	Site visitor	64%	£11.63	£9.48
Dunwich (2)	1988	101	Site visitor	61%	£11.87	£6.87
Spurnhead (2)	1988	97	Site visitor	80%	£14.68	£8.50
Resorts/ Developed sites						
Corton (residents) (4)	2001	163	Residents	82%	£2.49	£2.27
Corton (Staying visitors) (4)	2001	304	Staying visitors	92%	£3.76	£3.42
Herne Bay (Residents) (5)	1990	189	Residents	83%	£5.31	£3.59
Peacehaven (Cliff tops) (2)	1988	214	Residents	54%	£6.05	£3.50
Filey (2)	1988	88	Site visitor	88%	£6.29	£3.64
Scarborough (2)	1988	101	Site visitor	83%	£8.52	£4.93
Morecambe (2)	1989	150	Site visitor	92%	£9.24	£5.76
Bridlington (2)	1989	151	Site visitor	86%	£9.48	£5.91
Cliftonville (6)	1993	528	Site visitor	81%	£9.84	£7.47
Lee-on-Solent (7)	1995	NA	Site visitor	NA	£10.93	£8.63
St Mildred's Bay (8)	1992	462	Site visitor	71%	£11.90	£8.77
Hastings (2)	1988	247	Site visitor	66%	£13.33	£7.72
Hunstanton (2)	1989	152	Site visitor	90%	£14.03	£8.74
Frinton (2)	1988	178	Site visitor	70%	£16.51	£9.56
Herne Bay Visitors (5)	1990	127	Site visitor	88%	£17.02	£11.50
Clacton (2)	1989	146	Site visitor	67%	£16.88	£10.52
Clacton (2)	1988	170	Site visitor	90%	£17.20	£9.96

Sources for the case study data shown in Tables 8.5, 8.6 and 8.7 are as follows:
(1) Fouquet *et al.,* 1992; (2) Penning-Rowsell *et al.,* 1989;1992; (3) Tapsell *et al.,* 1996; (4) Tunstall, 2001; (5) Tunstall *et al.,* 1990; (6) Garner *et al.,* 1994; (7) Whitmarsh *et al*. 1999; (8) Costa *et al.,* 1993.
(9) Survey data in Tables 8.5 -8.10 updated to March 2005 (2005 Q1) using UK Economic Accounts Table 1.1 National accounts aggregates Index numbers, Implied deflators, GDP at market prices (column YBGB) as of 12.7.2005.

Table 8.6 £ losses per adult visit with erosive changes at coastal sites

Site	Change with erosion	% expecting less enjoyment	£ mean loss per adult visit - updated to March 2005 (£ mean loss per adult visit - at survey date)				£ mean loss: All - at survey date
			Local	Day	Staying	All	
Beach and promenade erosion							
Yellow Manual Standard data: 4 sites	Deterioration in beach and promenade	85%	2.54 (1.58)	3.80 (2.37)	8.91 (5.55)	5.76	3.59
Lee-on-Solent	Shingle beach erosion	NA	3.31 (2.61)	2.29 (1.81)	4.05 (3.20)	2.96	2.34
Herne Bay Visitors survey	Deterioration in beach, seawall and promenade collapsed in parts		2.87 (1,.94)	2.69 (1.82)	11.19 (7.56)	5.53	3.74
Cliftonville	Cliff erosion, deterioration in beach, cliff top promenade closed in parts	83%	6.97 (5.29)	6.81 (5.17)	6.08 (4.62)	6.37	4.84
Corton (Residents staying visitors)	Cliff erosion, deterioration in beach and seawall, very reduced access to, and along beach and seawall	81%	2.28 (2.08)	-	1.12 (1.02)	2.08	1.89
St Mildred's Bay	Severe damage to esplanade wall, esplanade unsafe and closed in parts	92%	7.44 (5.48)	8.43 (6.21)	8.86 (6.53)	8.29	6.11
Hastings	Beach deterioration	NA	NA	NA	NA	5.87	3.40
Breach scenarios							
Hengistbury Head	Breach, boat access only to Head, reduced cliff top area and paths	62%	4.01 (3.27)	2.95 (2.40)	3.22 (2.62)	3.46	2.82
Hurst Spit	Breach to shingle spit, access by boat only	98%	2.57 (1.83)	6.78 (4.84)	3.81 (2.72)	5.21	3.72

Table 8.7 £ gains per adult visit with coastal protection scheme options at coastal sites

Site	Change with scheme options	£ mean gain per adult visit – updated to 2004 (£ mean gain per adult visit – at survey date)				£ mean gain: All at survey date
		Local	Day	Staying	All	
Beach and promenade erosion						
Yellow Manual Standard data: 4 sites	Nourished beach and promenade	1.67 (1.04)	2.89 (1.80)	2.10 (1.31)	2.39	1.49
Lee-on-Solent	(a) Shingle beach renourishment	1.39 (1.10)	1.33 (1.05)	1.37 (1.08)	1.37	1.08
	(b) Rock groynes with shingle beach renourishment	1.47 (1.16)	1.28 (1.01)	0.81 (0.64)	1.34	1.06
Herne Bay Visitors survey	(a) Reef or jetty with no boat facilities	3.05 (2.06)	2.62 (1.77)	5.83 (3.94)	4.03	2.72
	(b) Reef or jetty with boat facilities	2.89 (1.95)	1.97 (1.33)	1.82 (1.23)	2.09	1.41
	(c) Higher seawall, and promenade, rock groynes	-1.83 (-1.24)	-2.62 (-1.77)	-2.96 (-2.00)	-2.59	-1.75
Cliftonville	(a) Concrete lower promenade	1.88 (1.43)	1.71 (1.30)	4.52 (3.43)	3.59	2.73
	(b) Rock lower promenade	0.96 (0.73)	1.47 (1.12)	2.66 (2.02)	2.12	1.61
Corton	(a) Hold the line for a limited period Short term protection to cliff, limited access to beach and along seawall	2.19 (1.99)		2.02 (1.84)	2.06	1.88
	(b) Hold the line for a longer period >50 years Full access along renewed seawall and onto all the beach from village	14.98 (13.64)		7.50 (6.83)	9.22	8.40
	(c) Managed retreat Sea defences and seawall removed to leave a 'natural' seafront', direct access from village to beach	-0.22 (-0.20)		1.99 (1.81)	1.43	1.30
St Mildred's Bay	Improved beach and promenade	2.56 (1.89)	1.86 (1.37)	2.13 (1.57)	2.25	1.66
Breach Scenario						
Hengistbury Head	(a) 5 rock groynes full cliff protection	-0.01 (-0.01)	0.48 (0.39)	-0.20 (-0.16)	0.04	0.03
	(b) 3 rock groynes partial protection	-1.95 (-1.59)	-0.97 (-0.79)	-2.45 (-2.00)	-1.93	-1.57
	(c) Beach nourishment Annual disruption	-1.77 (-1.44)	-2.87 (-2.34)	-4.23 (-3.45)	-2.91	-2.37
Hurst Spit	Slightly enlarged shingle spit	0.88 (0.63)	0.35 (0.25)	0.63 (0.45)	0.55	0.39

Table 8.8 £ Value of enjoyment of today's visit for river sites

Site	Survey year	Sample size	% able to value	£ mean value of enjoyment of today's visit: updated to March 2005	£ mean value: at survey date
River Misbourne: Low flows (1)					
Visitors	1994	231	73%	5.79	4.43
Residents	1994	150	74%	4.84	3.75
River Wey: Low flows (1)					
Residents	1994	146	69%	3.00	2.33
River Ravensbourne: Full River restoration (2)					
Visitors	1991	210	58%	2.34	1.67
Residents	1991	183	52%	1.81	1.29
Visitors and residents	1991	393	55%	2.08	1.49
River Skerne: River restoration (3)					
Residents	1995	252	48%	7.68	6.00

Table 8.9 £ Value of losses and gains per visit for various changes at river sites

Site	£ mean loss: updated to March 2005	£ mean loss: at survey date	£ mean gain: updated to March 2005	£ mean gain: at survey date
River Misbourne: Low flows (1)				
Visitors	3.66	2.80	2.14	1.64
Residents	3.65	2.83	1.81	1.40
River Wey: Low flows (1)				
Residents	1.51	1.17	2.08	1.61
River Ravensbourne: Full River restoration (2)				
Visitors and residents	-	-	1.92	1.37
River Skerne: River restoration (3)				
Residents	-	-	2.43	1.90

Source of data in Tables 8.8 and 8.9: (1) House *et al.,* 1994; (2) Tapsell *et al.,* 1994; Tapsell, 1995; (3) Tapsell *et al.,* 1997; Tunstall *et al.,* 1999.

Table 8.10 Willingness to pay for coastal protection

Site	Survey date	Sample size and type	Payment vehicle	WTP format	% WTP	£ mean WTP: Updated to March 2005	£ mean WTP: at survey date
Peace-haven cliff top	1988	214 Residents	Increased Rates and taxes p.a.	WTP diagram	55% overall		
				50p starting point		3.16	1.83
				£1 starting point		4.89	2.83
Herne Bay	1990	189 Residents	Extra national and local taxes p.a.	WTP diagram	73% overall		
				40p starting point		7.89	5.33
				80p starting point		9.43	6.37
Herne Bay	1990	143 Visitors	Extra national and local taxes p.a.	WTP diagram	55% overall		
				40p starting point		5.07	3.43
				80p starting point		6.67	4.51
Hurst Spit	1991	550 Visitors	Additional taxes p.a.	WTP payment ladder	74% overall		

Table 8.10 continued							
				25p starting point		12.93	9.22
				£32 starting point		56.96	40.63
St Mildred's Bay	1992	462 Visitors	Extra national and local taxes p.a.	WTP payment ladder and two starting points: 25p and £128	61% overall	42.67	31.44
Cliftonville	1993	528 Visitors	Small increase in national and local taxes p.a.	WTP payment ladder with two starting points: 50p and £64	62% overall	25.64	19.47
Caister (1)	1997	452	Extra taxes every year	Open question	NA		
		Visitors				37.46	31.62
		Local residents				30.62	25.84
Source of data in this table (1) Bateman *et al*. (2001). For other sources see Table 8.6.							

Table 8.11 £ value of enjoyment of an adult visit with the Corton options (2001 prices)

Option	Residents £ mean value per visit	Visitors £ mean value per visit	All respondents £ mean value per visit
'Do nothing' option	£0.33	£0.63	£0.53
'Managed retreat'	£1.26	£2.46	£2.14
Current seafront	£2.27	£3.42	£3.05
'Hold the line for a limited period'	£3.38	£3.45	£3.43
'Hold the line for a longer period'	£18.54	£10.14	£12.10

Table 8.12 Losses, gains and annual benefit estimates with the options at Corton (2001 prices)

	Local residents			Staying visitors			All
	Adult visit numbers	£ mean loss per visit	Annual £ loss	Adult visit numbers	£ mean loss per visit	Annual £ loss	Annual £ loss
'Do nothing'							
Halcrow	25,000	2.08	52,000	50,000	1.02	51,000	103,000
CV survey	38,447	2.08	79,970	58,702	1.02	59,876	139,846
	Local residents			Staying visitors			All
	Adult visit numbers	£ mean gain per visit	Annual £ gain	Adult visit numbers	£ mean gain per visit	Annual £ gain	Annual £ gain
Limited protection							
Halcrow	25,000	1.99	49,750	50,000	1.84	92,000	141,750
CV survey	38,447	1.99	76,510	58,702	1.84	108,012	184,521
Longer protection							
Halcrow	25,000	13.64	341,000	50,000	6.83	341,500	682,500
CV survey	38,447	13.64	524,417	58,702	6.83	400,935	925,352
'Managed retreat'							
Halcrow	25,000	-0.20	-5,000	50,000	1.81	90,500	85,500
CV survey	38,447	-0.20	-7,698	58,702	1.81	106,251	98,553

Table 9.1 'Tolerance' of flooding according to agricultural land use

Agricultural land use Type	Common minimum acceptable flood frequency: annual probability	
	Whole Year	Summer April-October
Horticulture	5%	1%
Intensive arable including sugar beet and potatoes	10%	4%
Extensive arable: cereals, beans, oil seeds	10%	10%
Intensive grass: improved grass, usually dairying	50%	20%
Extensive grass, usually cattle and sheep	≥100%	33%

Table 9.2 Drainage conditions for agriculture and water levels in fields and ditches

Agricultural drainage condition	Agricultural productivity class	Depth to water table from surface	Spring time free-boards in water-courses (natural drainage)	Spring time free-boards in water-course (field drains)
Good: 'rarely wet'	Normal, no impediment imposed by drainage	0.5 m or more	1m (sands), 1.3m (peats) 2.1m (clays)	1.2m (clays) to 1.6m sands (0.2m below pipe outfall)
Bad: 'occasionally wet'	Low, reduced yields, reduced field access and grazing season	0.3 m to 0.49 m	0.7m (sands) 1m (peats) 1.9m (clays)	Temporarily submerged pipe outfalls
Very bad: 'commonly or permanently wet'	Very low, severe constraints on land use, much reduced yields, field access and grazing season: mainly wet grassland	Less than 0.3 m	0.4m (sands) 0.6m (peats) 1m (clays)	Permanently submerged pipe outfalls

*Freeboard here is the height difference between the water in the ditch and adjacent field surface level. Required field water tables relate to conditions for crop growth and field access. Very low water tables can result in crop water stress. Naturally drained peat soils usually have freeboard requirements that approach those of sands: about 1.3m, 1m, and 0.6m respectively for the three categories above, but conditions can vary.

Table 9.3 Common farming performance field drainage conditions (England and Wales)

	Field Drainage Conditions		
	Good	Bad	Very Bad
Arable			
Yield as % of 'good' category			
Winter wheat and barley	100	80	50
Spring wheat and barley	100	90	80
Oil seed rape	100	90	80
Potatoes, Peas, Sugar Beet	100	60	40*
Typical wheat financial gross margin £/ha	£300-£350	£200-£250	£25-£75
Grassland			
Typical nitrogen use on grass kgN/ha	150 - 200	50 – 75	0 - 25
Grass conservation	2 cut silage	1 cut silage or graze	1 cut hay or graze
Typical stocking rates; Live-stock units/ha	1.7 - 2.0	1.2 - 1.4	0.7 - 1.0
Typical livestock type	Dairy, intensive beef and sheep	Beef cows, 24 month beef, sheep	Fattening of 'store' cattle, and sheep
Typical financial gross margins £/ha (after forage costs)	£1200-1400 (dairy) £400-500 (intensive beef/sheep)	£150-250	£100-150
Days reduction in grazing season compared to 'good' category	none	Spring: 14 to 21 Autumn: 14 to 21	Spring: 28 to 42 Autumn: 28 , no stock out in winter

Livestock units: dairy cow, 1 Lu; beef cow, 0.8 Lu; 24 month beef, 0.7 Lu; sheep plus lamb, 0.14 Lu.
A grazing day is worth about £1.12/lu in spring, £0.8/lu in autumn, and £0.38/lu in winter in terms of savings in housing costs and feed conservation costs. *not grown if persistently 'very bad'.

Table 9.4 The value-added per hectare by arable crops is measured by estimating the value of output and subtracting costs to derive estimates of gross margins and net margins

	£, 2005 values		Winter wheat	Oil seed rape	Peas	Beans	Sugar Beet	Potatoes
a	Yield	t/ha	8.5	2.8	4.0	4.0	55.0	45.0
b	Price	£/t	70	140	85	85	32	90
c	Output (a*b)	£/ha	595	392	340	340	1760	4050
d	Area Payment	£/ha	0	0	34	34	0	0
e	Gross Output (c+d)	£/ha	595	392	374	374	1760	4050
f	Variable Cost	£/ha	250	225	185	130	650	1800
g	Gross Margin (e-f)	£/ha	345	167	189	244	1110	2250
	Fixed Costs							
	Semi Fixed							
	Labour	£/ha	48	43	40	32	105	242
	Machinery	£/ha	66	57	60	52	90	318
	Buildings (dry & store)	£/ha	11	8	7	7	8	48
	Other	£/ha	10	12	9	8	13	44
h	Sub total	£/ha	135	120	116	99	216	652
	Full Fixed Costs							
	Labour	£/ha	67	80	59	48	131	331
	Machinery	£/ha	168	153	149	130	226	796
	Buildings (store)	£/ha	30	26	21	21	11	159
	General expenses	£/ha	48	59	45	41	66	220
i	**Total Fixed Costs**	**£/ha**	**313**	**318**	**274**	**240**	**434**	**1506**
	Financial Returns							
	Net Margin/Crop							
j	after semi fixed costs (g-h)	£/ha	210	47	73	145	894	1598
k	after full fixed costs (g-i)	£/ha	32	-151	-85	4	676	744
	Economic Returns (Defra PAG3, Scenario II: one-off loss)							
	Economic adjustment	%	None	None	Remove area payment		Treat as wheat crop	
l	Reduction in Gross Output		0	0	34	34	0	0
m	Adjusted Gross Output (e-l)	£/ha	595	392	340	340	595*	595*
n	**Adjusted Gross Margin (g-l)**	**£/ha**	**345**	**167**	**155**	**210**	**345***	**345***
	Economic Returns (Defra PAG3, Scenario III: permanent loss)							
	Economic adjustment	%	None	None	Remove area payment		Treat as wheat crop	
	Adjusted Gross Margin (n)	£/ha	345	167	155	210	345*	345*
	Adjusted Net Margin							
o	After semi-fixed costs (n-h) or wht	£/ha	210	47	39	111	210*	210*
p	**After full fixed costs (n-i) or wht**	**£/ha**	**32**	**-151**	**-119**	**-30**	**32***	**32***

Notes:*treated as a wheat crop for economic analysis
Figures subject to minor rounding errors
Area payments discontinued in 2005, EU protein supplement retained for beans and peas
In 2005, single payments for arable farmers are about £250/ha for eligible land previously in receipt of area payments
Excluding land rent and land purchase costs, which are omitted from economic analysis
Wheat yields are 'average' for first and subsequent crops in rotation. Barley GMs about 75% of wheat GM
Source: Farm Business Survey, ABC, Nix, SAC, and Defra sources, Regional and local estimates may vary

Table 9.5 The value-added by dairy and livestock enterprises is derived by estimating the value of output per head, subtracting costs to obtain gross and net margins per head, and then multiplying by stocking rates to derive margins per ha.

	£, 2005 values		Dairy Cows	Beef Cows	Beef Cattle	Sheep
a	Gross Output	£/head	1150	250	180	48
b	Variable Costs	£/head	460	150	95	27
c	Gross Margin (a-b)	£/head	690	100	85	21
	Fixed Costs					
	Semi Fixed					
	Labour	£/head	147	40	21	12
	Machinery	£/head	57	30	23	5
	Buildings	£/head	16	9	5	2
	Other	£/head	21	14	6	1
d	Sub total	£/head	241	93	55	20
	Full Fixed Costs (excluding land and related building costs)					
	Labour	£/head	273	103	55	30
	Machinery	£/head	103	55	42	8
	Buildings	£/head	50	28	16	7
	General expenses	£/head	105	70	31	9
e	Total Fixed Costs	£/head	531	256	144	54
	Net Margin per head					
f	After semi fixed costs (c-d)	£/head	449	7	30	1
g	After full fixed costs (c-e)	£/head	159	-156	-59	-33
h	**Typical Stocking rates: Head per ha**		**2**	**1.7**	**4**	**11**
	Financial Returns (excluding single farm payments)					
	Returns per hectare					
i	Gross Output (a*h)	£/ha	2300	425	720	528
j	Gross Margin (c*h)	£/ha	1380	170	340	231
	Net Margin					
k	After Semi Fixed Costs (f*h)	£/ha	898	12	120	11
l	After Full Fixed Costs (g*h)	£/ha	318	-265	-236	-363
	Economic Returns (Defra PAG3, Scenario II: one-off loss)					
	Economic Adjustment	%	Wheat*	None	None	None
m	**Adjusted Gross Margin**	**£/ha**	**345**	**170**	**340**	**231**
	Economic Returns (Defra PAG3, Scenario III: permanent loss)					
	Economic Adjustment	%	Wheat*	None	None	None
	Adjusted Gross Margin (m)	£/ha	345	170	340	231
	Adjusted Net Margin					
n	After Semi Fixed Costs (k or wht)	£/ha	210*	12	120	11
o	**After Full Fixed Costs (l or wht)**	**£/ha**	**32***	**-265**	**-236**	**-363**

Notes: * dairy cow area treated as wheat for economic analysis
as from 2005, milk, and beef and sheep headage subsidies are discontinued, eligible farmers receive payments of £100-£350/ha depending on intensity of land use. Estimates exclude land rent and/or land purchase costs, which are omitted from economic analysis. Variable costs include average forage costs such as fertilisers on grass.
Beef cows: single sucklers, mix of autumn and spring born calves. Beef: finishing mix of suckled calves on grass (summer) and silage (winter).
Source: Farm Business Survey, ABC, Nix, SAC, and Defra sources, Regional and local estimates may vary

Table 9.6 Defra advise that different assumptions are made for alternative agricultural flood defence scenarios*

	Scenario I	Scenario II	Scenario III
	Land lost to agriculture	Temporary, one-off loss of agricultural output	Permanent reduction in the value of agricultural output
All agricultural land use	Loss assumed equivalent to 65% of prevailing land values		
Crops: Cereals; oil seeds; beans/ peas. Grassland: Beef and sheep		Loss of Gross Margins per ha (adjusted for possible savings in costs), plus clean-up costs	Reductions in Net Margins associated with change in flood and land drainage conditions
Other: Dairy; sugar beet; potatoes; high value fruit/ vegetables		As above, treated as though area occupied by wheat	As above, treated as though area occupied by wheat

* Based on Defra, 2005a (See also Tables 9.4 and 9.5 above)

Table 9.7 The main land use can be used to estimate the value of permanent loss of output from agricultural land

£/ha	Intensive arable including root crops	Cereals	Intensive grass (dairy)	Extensive grass
Indicative Financial Net Margins*	£260-300	£30-75	£180-200	£0-20
PV of loss of agric output* *	£4,000-4,600	£460-1,150	£2,750-3,060	£0-300

Notes: * excludes single farm payments **assumes 30 years at 5% commercial discount rate: 15.3 annuity factor. Economic discount rate would use an 18.4 annuity factor and cereals as a 'default' for intensive arable and dairy land.

Table 9.8 Broad-scale estimates of the cost of a single annual flood vary according to Agricultural Land Class (ALC)

Agricultural Land Class (Grade)		Land use					£/ha
		Horticulture	Intensive arable	Extensive arable	Intensive grass	Extensive grass	Flood costs
1	% of area	5%	85%	10%			
	Flood cost £/ha	4800	1030	450			**1160**
2	% of area	5%	60%	35%			
	Flood cost £/ha	3080	780	430			**770**
3a	% of area		30%	70%			
	Flood cost £/ha		530	350			**400**
3b	% of area			50%	50%		
	Flood cost £/ha			270	50		**160**
4	% of area				100%		
	Flood cost £/ha				50		**50**
5	% of area					100%	
	Flood cost					20	**20**

Crop damage based on loss of gross margin, less savings in uncommitted costs. Grassland costs based on value of replacement feed. Extensive arable land use provides a 'default' for all arable land and for intensive dairy land.

Table 9.9 Financial and economic returns vary by land use type and drainage condition

Land Use Type £/ha, 2005 values	Drainage Condition	Financial Gross Margin	Financial Net Margin	Economic Gross Margin	Economic Net Margin
1. ***Extensive grass*** Beef cows, cattle, and sheep	Good	247	-290	247	-290
	Bad	173	-203	173	-203
	Very Bad	124	-145	124	-145
2. ***Intensive Grass*** Diary herd (80%) plus beef cattle (20%)	Good	1138	202	325	-32
	Bad	797	141	215	-85
	Very Bad	569	101	63	-191
3. ***Grass/Cereal Rotation*** (type 2 at 50%, Type 4 at 50%)	Good	742	117	335	0
	Bad	511	43	221	-70
	Very Bad	308	-51	55	-197
4. ***All Cereal*** Winter wheat	Good	345	32	345	32
	Bad	226	-55	226	-55
	Very Bad	48	-203	48	-203
5. ***Extensive Arable*** Wheat/beans or peas/oil seeds	Good	299	-7	296	-11
	Bad	205	-75	201	-79
	Very Bad	69	-185	65	-189
6. ***Intensive Arable*** Cereals, potatoes, sugar beet	Good	799	263	345	32
	Bad	325	-124	226	-55
	Very Bad	10	-369	48	-203

Notes: In addition, farmers may receive single farm payments equivalent to about £250/ha for eligible arable land, £100 to £250 /ha for grassland with beef and sheep, and up to £360/ha for dairy land
Based on Table 9.4 and 9.5: **shaded cells** denote non-viable land use to achieve full cost recovery. On land use 1, reductions in stocking rates of livestock are likely in the longer term.

Table 9.10 Flood costs (£/ha) vary by drainage condition, land use type, flood frequency and type of catchment (£/ha/year, 2005 prices)

Large Catchment: Catchment > 25km², 80% winter flooding								**Small Catchment**: Catchment <25km², 60% winter flooding							
Drainage Condition	LUT*	**Flood return period (years between floods)**						**Drainage Condition**	LUT*	**Flood return period (years between floods)**					
		0.5	**1**	**3**	**5**	**10**	**20**			**0.5**	**1**	**3**	**5**	**10**	**20**
Good	**1**	36	18	6	4	2	1	**Good**	**1**	54	27	9	5	3	1
	2	50	25	8	5	3	1		**2**	76	38	13	8	4	2
	3	75	38	13	8	4	2		**3**		104	35	21	10	5
	4		50	17	10	5	3		**4**			57	34	17	9
	5			53	32	16	8		**5**				94	47	23
	6					50	25		**6**						50
Bad	**1**	26	13	4	3	1	1	**Bad**	**1**	32	16	5	3	2	1
	2	44	22	7	4	2	2		**2**	68	34	11	7	3	2
	3	74	37	12	7	4	2		**3**		90	30	18	9	4
	4		74	25	15	7	4		**4**			48	29	15	7
	5			37	22	11	6		**5**				63	32	16
	6					35	18		**6**					65	33
Very bad	**1**	16	8	3	2	1	1	**Very Bad**	**1**	22	11	4	2	1	1
	2	30	15	5	3	2	1		**2**	44	22	7	4	2	1
	3	68	34	11	7	3	2		**3**		66	22	13	7	3
	4		58	19	12	6	3		**4**			36	22	11	5
	5			27	16	8	4		**5**				46	23	11
	6				50	25	13		**6**					30	15

* NOTES:
**Land Use Type*
(1) Extensive grass *(4) All cereals*
(2) Intensive grass *(5) Extensive arable*
(3) Grass/arable rotation *(6) Intensive arable*

Estimates based on short duration, less than one week, flooding, allowing for yield loss, reseeding costs where relevant, net of savings in uncommitted cost. Blank cells denote land use type unlikely to occur at given flood return period

Table 9.11 The assessment of the impacts of flood risk management on agriculture involves a range of information derived from site observation and discussions with land managers

1. Benefit area definition
Area over which flood defence and drainage works exert influence; in terms of flood risk and ground water levels, including tributary arterial systems affected directly or indirectly by the flood management works. Relevant organisational aspects: Internal Drainage Board areas, Main Rivers, Local Authority ditches, Farmer ditches. History of capital and maintenance works, purpose and justification. Evidence of changes in land use and farming practice over time, especially flood risk management standards, records of events, aerial photos. A set of 1:2500 series maps covering the benefit area is essential for farmer interview, and for determining field areas, water courses, scheme boundaries, and the location of other salient features.
2. Farm level data (for the farm in the benefit area)
Percentage of the farm area in the benefit area, Farm size (ha). Topography, major soil types, and agro-climate. Cropping pattern (crops by area). Livestock types, numbers, ages, systems. Ownership type: owner, tenant, partnership. Number of family and hired workers. Major changes in farm circumstances and practice over past five years. Current development proposals and factors influencing/limiting. Relevant environmental features and qualities: Participation/eligibility in agri-environment schemes. Relevant fixed cost scenarios for expected changes in crop and livestock activities. Typical land values: purchase, rents.
3. Farmer characteristics (as they affect motivation)
Age, length of occupancy, qualifications, experience. Business orientation: commercial, lifestyle issues, environmental/conservation interest and actions. Extent of non-farming commercial activities: dependence on farming. Experience of farming elsewhere. Inheritance: farming with sons or daughters. Membership of local groups: farmer, drainage, conservation groups. Importance attached to drainage for agriculture.
4. Field level (or blocks of fields with similar features)
Soil type Field size (ha). Tenure status and length of occupancy. Distance from, and contiguity with, farm. Whether under-drained or not (pipe/mole drains, drain conditions, ditch system, outfall facility in ditch, standards of maintenance, pumping). Predicted with and without scheme flood risk and drainage conditions by fields - groups:

4. Continued
▪ Drainage condition; wetness class (four types: permanently wet, commonly wet, occasionally wet, rarely wet). ▪ Flood frequency and areas by return period. ▪ seasonality (particular months of year). ▪ Flood duration (days, weeks, months). ▪ Flooding depth (mm). ▪ Other flood water issues: quality, turbulences, damage to structures, livestock at risk ▪ Percentage of field liable to flooding. Field drainage requirements: type, design, costs, percentage of field in need of drainage. Evidence of flooding: crop damage, high water levels (flood tolerant species, stressed crops, tractor wheelings, muddy cattle, blocked drains/channels/debris, reports of 'muddy floods')
5. Land-use and enterprise level data
Grassland Grassland site class: poor, average, good, very good (as defined by soils, climate and available soil water). Grass type: permanent, temporary, improved ryegrass, rough grazing, presence of sedge/ rushes. Drainage condition: good, bad, very bad (reflecting ground water levels, high ditch levels, heavy soils, damaged artificial drains). Poaching risk: whether soils liable to surface damage when wet by animals (and machines). Nitrogen use (kgN/ha) as it defines grass yields. Grass conservation type: graze, hay, silage, and timing and number of cuts. Stock types and performance levels: dairy, dairy replacements, beef cows and sucklers, 24-30 month beef, store cattle at grass, sheep. Typical yields for milk (l/cow/year, usual live-weights bought and sold, prices for milk, beef, sheep). Beginning and end of grazing season, spring and autumn, outside over-wintering of cattle and sheep. Fixed cost assumptions; as a result of the changes (either increase or decrease in output due to flood defence; will there be any increase or decrease in any of the following: breeding herd, labour, machinery, buildings, for grass and livestock production.
Arable Crop type: cereals, oil seeds, legumes, root crops (potatoes, carrots, sugar beet, vegetables (brassicas, onions), salad crops (lettuces, celery), soft fruit (strawberries), top fruit (apples, pears). Crop yield (t/ha), prices (£/t) and quality aspects as they affect prices. Crop rotation (crop type, including grass, and number of years for each). Fixed costs assumptions: labour, machinery, buildings: will any changes in flood defence affect 'fixed costs' such as labour machinery, buildings, use of contractors.

On large schemes, where there is homogeneity of farm type and practice, the formulation of whole farm budgets which show the implications of major changes in farming activities and resource use is likely to be needed.

Table 9.12 Agricultural flood defence investment appraisal involves comparing with and without project situations to derive an estimate of Net Present Value

Agricultural Flood Defence Rehabilitation Investment Appraisal: a simplified example
Determine the justification for a scheme to continue existing standards of Flood Defence on 1000 ha
Without scheme situation offers scope for environmental option.

Financial Analysis: the farmer's viewpoint									*Economic Analysis : the national economic viewpoint*				
£, 2005 prices													
With Defence		a		b		c	b-c=d	a x d	b*		c	b*-c=d*	a x d*
	% of area	Area ha	Drainage	Net return	Flood Risk	Flood cost	Net Return	Net Return	Net return	Flood Risk	Flood cost	Net Return	Net Return
		1000	Conditions	£/ha	(yr interval)	£/ha	£/ha	£	£/ha	(yr interval)	£/ha	£/ha	£
LUT 2	0.4	400	good	202	5	5	197	78694	-32	5	5	-37	-14805
LUT 3	0.15	150	good	125	10	4	121	18150	0	10	4	-4	-571
LUT 4	0.45	450	good	32	20	3	29	13230	32	20	3	29	13230
Subtotal per year							A	110074				A*	-2145
Without Defence													
LUT 1	0.8	800	very bad	-145	1	8	-153	-122263	-145	1	8	-153	-122263
LUT 2	0.2	200	bad	141	1	22	119	23843	-85	1	22	-107	-21365
Subtotal							B	-98420				B*	-143628
With - Without (before environmental payments)/year							A-B=C	208494				A*-B*=C*	141482
Adjustment for environmental payments													
		a		b				a x b	b*				a x b*
wetgrass	0.55	550	very bad	150				82500	150				82500
LUT 4 conv	0.45	450	bad	250				112500	250				112500
							D =	195000				D* =	195000
Benefit due to project (including adjustment for env payments)							C -D = E	13494				C*-D*=E*	-53518
£, 2005 prices				Financial Analysis					Economic Analysis				
				Excl Env		Incl Env					Excl Env		Incl Env
Benefits				receipts		receipts					benefits		benefits
Annual series			from C	208494	from E	13494				from C*	141482	from E*	-53518
Annuity 30 years			at 6% DR	14		14				at 3.5% DR	18		18
Present value				2877219		186219					2603272		-984728
Project Costs													
PV Capital costs					1700000							1700000	
PV O&M at 2.5%/yr					586500							586500	
Total PV costs					2286500							2286500	
Net Present Value				590719		-2100281					316772		-3271228
	per ha			591		-2100					317		-3271
B:C ratio				**1.26**		**0.08**					**1.14**		**-0.43**

Table 10.1 Possible outcomes

EBPO	NBO		
	b/c >> 1	b/c >1	b/c <1
b/c >> 1	Do BPEO	impossible	impossible
b/c > 1	Do BPEO	B	B
b/c < 1	A	B	B

Table 10.2 Potential functions of a wetland (N.B. not all wetlands of all types provide all functions and some functions are mutually exclusive of each other)

Flood attenuation and control
Prevention of saline water intrusion
Groundwater recharge and/or discharge
Flow regulation
Sediment retention
Storage and recycling of organic matter and nutrients
Storage and recycling of toxic material
Regulation of biological control mechanisms
Maintenance of migration and nursery habitats
Food web support
Maintenance of biological diversity
Storage of carbon dioxide (but freshwater wetlands may be net emitters of methane)
Provision of agricultural services (e.g. pasture; reeds)
Food resource provision: fishery and wildfowl
Medicinal resources
Shoreline stabilisation

Table 10.3 Predicted and actual habitat creation and management costs

HABITAT TYPE	ACTIVITY COSTED	PREDICTED COST £/Ha Source: UK Biodiversity Group (2000)	ACTUAL COST £/Ha Source: Shepherd *et al*. (2002)	ACTUAL COST £/Ha Source: Shepherd *et al*. (1999)
Mudflats		Inadequate techniques to be costed		
Sand dunes	Scrub removal Grazing reintroduction Agri-environment scheme to promote vegetation restoration	1000 800 245		
Cliffs and slopes	Scrub control and grazing Agri-environment scheme to promote vegetation restoration	100 245		
Saltmarsh	Creation Agri-environment scheme for management	400 50		
Coastal grazing marsh	Creation			800-1,200
Vegetated shingle	Restore shingle morphology Re-establish vegetation	10,000 500		
Coastal lagoons	Creation		6,700*	4,200-57,000
Reed beds	Maintenance Re-creation	100 620	3,200	2,800-7,700

*Includes land purchase