Joint Defra/EA Flood and Coastal Erosion Risk Management R&D Programme

Annex B.6:

Case study no.6:

Assessment of the Lower Don strategy study

R&D Project Record FD2013/PR2

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Statement of use
This report provides guidance on the use of MCA and ASTs to assist in the appraisal of flood and coastal erosion risk management projects, strategies and policies. It should be noted that it does not constitute official government policy or guidance, which is unlikely to be available until work to develop the methodology and identify appropriate sources of data has been undertaken through pilot studies.

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1. Introduction

This report presents the MCA-based project appraisal process for part of the Lower Don Flood Defence Strategy Study. This strategy assessment was based on the original appraisal process carried out on behalf of the Environment Agency (EA).

The information reported here is based on the following document:

Atkins (2004): Lower Don strategy study - draft report, report produced for the Environment Agency North East Region, March 2004.

This strategy study is associated and linked with the Upper Don strategy plan, and they both will provide the overall framework for flood protection in the Don catchment.

The appraisal approach followed in this strategy study is in many ways similar to the one followed in the MCA-based approach, in particular in relation to the following points:

- it bases the option appraisal on strategic objectives and sub-objectives and covers very similar issues to those covered in the impact types and categories used in the Assessment Summary Tables (ASTs) prepared for the MCA-based methodology; and
- it uses a simple scoring system to assess each of the proposed options in relation to each of the strategic objectives and sub-objectives.

These characteristics were used to illustrate key issues arising from the current flood defence appraisal process and these are tackled in the MCA-based approach.

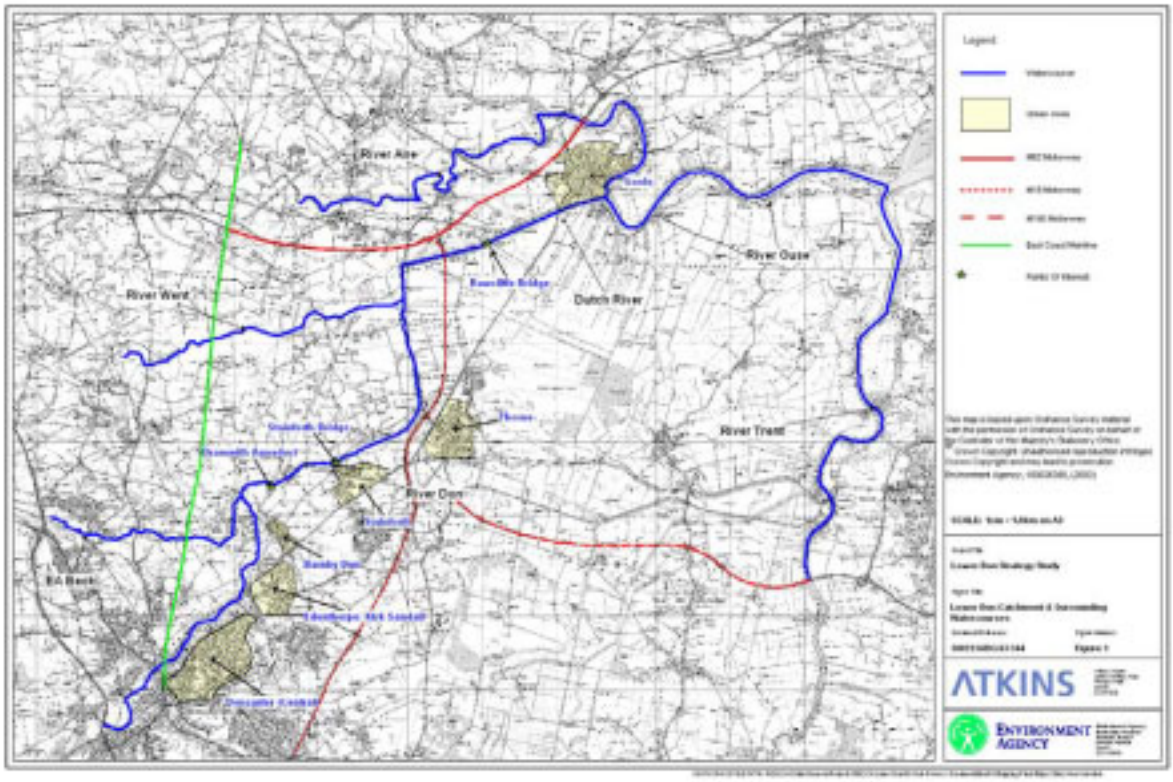
Acknowledging that government guidance recommends a 100-year time horizon, the time horizon chosen for this strategy is 50 years. This is because of a number of external factors such as development of robust climate change predictions, changes in government policy and legislation, and stakeholder acceptability (Atkins, 2004). In addition, the policies and measures developed for the next 50 years and the prioritised 5-year programme of works are considered not to change should the 100-year appraisal period be adopted (Atkins, 2004).

1.1 Summary of the project area

The area covered by the Lower Don Strategy Study includes the River Don between Doncaster and Goole. Wheatley has been taken as the upstream limit of the study for the right bank and the confluence of the Ea Beck with the River Don has been taken for the left bank. The downstream limit is Goole, located at the confluence with the River Ouse. Figure 1.1 illustrates the area being considered.

The total area of the Don catchment is 1682km^2, but the Lower Don study area only covers approximately 400 km^2 of the total.

Figure 1.1 Overview of the Lower Don catchment study area (adopted from Atkins, 2004)



This strategy study covers the lower part of the River Don catchment, including its tributaries the Rivers Aire, Went, Ouse and Ea Beck. Located within the study area are the urban areas of Goole, Thorne, Stainforth, Edenthorp Kirk Sandall and Doncaster. However, the majority of the study area is covered by agricultural land.

The Lower Don area is crossed by the M62 and M18 motorways and by the East Coast Mainline railway.

1.2 Existing defences

A fundamental consideration of this strategy is the inter-relationship between the Lower Don and neighbouring rivers in respect to shared flood risk. In order to investigate risk issues associated with the River Don, neighbouring rivers and relatively low lying areas in between, the river catchment has been divided into Flood Management Units (FMU). A FMU is defined as the area at risk from inundation following a catastrophic breach of the flood defence system from one or more of the surrounding watercourses, which is not repaired. Furthermore, the flood defence forming each FMU have been divided into discrete sections/stretches, primarily based on individual reaches identified as part of the geotechnical risk assessment undertaken previously. Flood defence reaches

have been classified according to the sampling frequency and embankment ground conditions. Five FMUs have been defined for the Lower Don catchment and are presented and described in Table 1.1.

Table 1.1: Flood management units for the Lower Don

FMU	Description
1 Goole, Aimyn, Rawcliffe	The River Ouse at Goole and Hook forms the eastern side of the FMU. The River Aire between Snaith and Airmyn forms the northern boundary with the western edge being formed by relatively high ground in the vicinity of Snaith, Cowick and Pollington. The River Went and the Dutch River, to the south, complete the FMU boundary. The Aire-Calder Navigation and M62 pass east-west across the FMU, and there are significant drainage structures connecting through these assets.
2 Thorn, Crowle, Reedness	FMU 2 is the largest single unit within the Lower Don Strategy. The western edge is defined by the right bank of the River Don between Thorne and New Bridge. The Dutch River and the River Ouse, downstream to Trent Falls, forms the northern boundary. In the east it is bounded by the River Trent from approximately Keadby to its confluence with the River Ouse. The southern perimeter has been assumed as the M180 motorway since this boundary has historically been used in previous studies. Both the M180 and the Stainforth – Keadby Canal are assumed to have significant drainage connectivity through them.
3 Kirk Bramwith, Fishlake, Sykehouse	The east of FMU 3 is bounded by the River Don between the River Went and Ea Beck. The latter two watercourses form the northern and southern edges respectively. A large extent of the western boundary is defined by the East Coast Main-line railway for the purpose of this study. The railway is situated to the west of New Junction Canal. There is significant drainage connectivity under the canal giving rise to potential flooding towards the railway. This is generally mitigated by the local topography to the west. However a low lying area exists in the vicinity of Owsten Wood and Tilts Farm, where flooding may occur from the locality of Thorpe in Balne.
4 Stainforth, Hatfield	FMU 4 is bounded in the north by the River Don. The remainder of the cell is enclosed by relatively high ground or man-made features. The South Western side of the FMU is formed by higher ground, which passes through the centre of Stainforth and the northern edge of Hatfield. It has been assumed for the purpose of this study that the M18 forms the eastern edge although in reality flood flows may pass through various drainage structures constructed under the motorway into FMU 2.
5 Edenthorp, Kirk Sandall	The River Don forms the north and west edges of FMU 5. All remaining areas are contained by surrounding higher ground in the Edenthorpe, Wheatley and Kirk Sandall areas. The downstream limit of the FMU is assumed to be near an area of high ground adjacent to Stainforth. In reality some connectivity exists with FMU 4 in the South Bramwith area.

Flooding within the Lower Don catchment can be caused by two main reasons (i) flood waters overtopping a flood defence embankment; or (ii) failure of the embankment. Both events would result in a flow path from the river into surrounding low-lying areas.

The existing flood defences are becoming increasingly old and consequently it is anticipated that some may have little residual life remaining. The risk of embankment failure is therefore reaching an unacceptable level.

A condition assessment for the 132 km of defences in the Lower Don was undertaken. Many sections of the existing defences are raised earthen embankments, which vary between 2 and 6m in height depending on their location. In numerous areas the river channel edges have been protected with stone to prevent scouring. Sheet pilling has been used in some localised areas. The existing defences vary considerably in age and some have a limited residual life. 52% of the total length of embankment examined (not all defences were assessed due to time and money constraints) was estimated as having a very high likelihood of failure.

An indicative assessment of the overall risk of flooding for the Lower Don has also been carried out using a strategic risk assessment tool developed as part of the strategy study. The strategic risk assessment is based on three risk parameters (time remaining before risk of breach becomes unacceptable, standard of protection against overtopping and consequences of flooding due to breach and/or overtopping), and assigns a risk of flooding rating to each defence reach within the FMUs.

The estimated standards of protection from overtopping in the Lower Don are illustrated in Table 1.2.

Table 1.2: Estimated standard of protection against overtopping

Water course	**Estimated standard of defence against overtopping**
Lower Don – Left Bank	1 in 50 years
Lower Don – Right Bank	1 in 100 years
Dutch River – Left Bank	1 in 100 years
Dutch River – Right Bank	1 in 50 years
Ea Beck – Left Bank	1 in 50 years
Ea Beck – Right Bank	1 in 50 years
River Went – Left Bank	1 in 50 years
River Went – Right Bank	1 in 50 years
River Aire – Right Bank	1 in 100 years
River Ouse – Right Bank	1 in 100 years
River Humber – Right Bank	1 in 100 years
River Trent – Right Bank	1 in 50 years

In addition to the flood embankments, there are eight flood warning areas in the Lower Don catchment. Both the River Don at Doncaster and the River Don at Bentley flood warning areas are categorised as ‘Severe Flood Warning‘ areas meaning more than 100 properties are at risk from flooding.

1.3 The policy framework

The Lower Don strategy study has links to many other strategic documents and plans. It follows from the Lower Don preliminary strategic report (PSR), it is associated and linked with the Upper Don strategy plan and has been running in parallel with the Lower Don strategic environmental assessment (SEA).

The Lower Don strategy study sits within the large scale catchment plans, therefore will also have major links with the forthcoming catchment flood management plan for the River Don. This will provide a large scale strategic planning framework for the integrated management of flood risk to people and the developed and natural environment in a sustainable manner.

1.4 List of stakeholders and interested parties

At the present stage of the Lower Don strategy study there is no indication that consultation has been undertaken, other than reference to the fact that stakeholders may or may not oppose the selection of the options. Moreover, no reference is made to a communication plan for future consultation.

2. Definition of objectives and management options

According to Atkins (2004), the primary aim of the Lower Don strategy study is to develop cost effective and sustainable strategic flood risk management policies and measures for the Lower Don catchment which seek to enhance the environment and compliment the needs of others where possible.

2.1 Strategic objectives

In addition to the main aim, a suite of strategic objectives was developed to enable the viability of a number of preliminary flood defence options and preferred flood defence policies and measures to be appraised. These strategic objectives have been developed using guidance provided in the flood and coastal defence project appraisal guidance (FCDPAG) 2 and in the Environment Agency's environmental impact assessment resource and receptors checklist. The strategic objectives have been supported further by a variety of sub-objectives and are presented in Table 2.1, below.

Table 2.1 Lower Don strategic appraisal objectives and sub-objectives

Strategic objectives		Sub-objectives
1	Reduce the risk of flooding to people, property and the environment taking account of social acceptability.	• improve defence standards where appropriate; • reduce the risk of embankment breach to an acceptable level; • improve flood warning services where appropriate; • control development in the flood plain; and • enhance flood storage where appropriate.
2	Ensure options are technically feasible in terms of reducing the flood risk.	• ensure preferred generic options, policies and measures reduce flood risk within the catchment where appropriate.
3	Ensure options are economically feasible.	• ensure preferred policies and measures for flood risk management are economically feasible by undertaking an initial economic appraisal.
4	Consider stakeholder acceptability of flood risk management generic options, policies and measures.	• ensure early feedback from statutory consultees is considered during the option appraisal process; • evaluate likely stakeholder feedback to generic options, policies and measures.
5	Improve the quality of life in terms of amenity, recreation and access.	• improve access and amenities for informal recreation; • create opportunities for informal recreation.
6	Protect and enhance biodiversity.	• ensure compatibility with nature conservation objectives at designated sites; • improve area, quality and distribution of BAP habitats; • improve numbers and distribution of BAP species; • restore natural river and floodplain habitats; • improve fisheries and reduce obstructions to fish movements.
7	Protect and enhance water, air and land quality.	• maintain and improve quality standards; • reduce contamination and the release of dangerous

Table 2.1 Lower Don strategic appraisal objectives and sub-objectives

Strategic objectives		Sub-objectives
		substances.
8	Protect and enhance landscape character/visual amenity.	• consider landscape character objectives; • enhance quality of landscape character; • provide flood defences in keeping with their environs.
9	Balance the needs of water users and improve river catchment management	• ensure compatibility with Don and Rother Catchment Abstraction Management Strategy (CAMS); • encourage uptake of Sustainable Urban Drainage (SUDS); • influence rural land management to reduce run-off; • improve aquifer recharge.
10	Achieve balanced approach to all land uses and regeneration.	• adopt and expand principles of South Yorkshire and North East Derbyshire Local Environment Agency Plan (LEAPS); • ensure that local businesses, rural economies and livelihoods remain viable; • avoid segregation of communities/social groups; • retain social fabric.
11	Protect and enhance features of archaeological and heritage interest.	• improve knowledge of sites/ features and their relevance; • prevent damage due to flood defence work.
12	Ensure compatibility with transport and other infrastructure	• maintain strategic communication and service links; • identify navigation opportunities; • consider impacts of future operations to avoid constrains.
13	Promote the principles of sustainable development.	• facilitate sustainable land use; • incorporate climate change effects; • promote natural flood plain functions; • facilitate sustainable use of materials.

2.2 Strategic options

Table 2.2 illustrates the generic flood defence options that were considered in the Lower Don Strategy Study. These options were then assessed against the strategic objectives defined above (no indication of the standards of defence provided was supplied in Appraisal Draft Report: Atkins, 2004).

Table 2.2 Summary of the generic options being considered in the Lower Don strategy study.

Options	Description
'Do-nothing'	Assumes that no further expenditure is spent on the repair and maintenance of the flood defences. This option is considered to be unacceptable. Large-scale inundation would result following a permanent breach in the defences and this would result in abandonment and write-off of large areas of residential, commercial and agricultural assets, and in environmental pollution. However, the River would be allowed to flow more naturally. In addition, this option has overriding stakeholder opposition.
Do minimum	Would involve continuing the current reactive maintenance regime for the flood defence assets. However, proactive asset replacement of flood

Table 2.2 Summary of the generic options being considered in the Lower Don strategy study.

Options	Description
	defence assets would not be carried out, which would result in embankment breaching. This option enables flood risk management based on limited resources, but the risk of breaching will become unacceptable, and the need for reactive works will increase with time as the likelihood of breaching increases. Significant flooding will occur whilst breach is repaired potentially resulting in the loss of life, environmental pollution and substantial economic losses. This option has overriding stakeholder opposition.
Flood warning	The aim is to provide areas adjacent to the Lower Don and its neighbouring watercourses with accurate and effective flood warnings to reduce the impact of flooding on local people and property. This is achieved by issuing a four stage flooding warning consisting of 'All Clear', 'Flood Watch', 'Flood Warning' and 'Severe Flood Warning' depending on predicted catchment flood conditions. A number of flood warning zones are currently in operation within the Lower Don catchment. Flood warning or contingency planning for the Lower Don by itself would not be sufficient. This is because flooding is most likely to be caused by breach failure. They would work in conjunction with flood defence capital intervention in areas consisting of isolated properties, which are insufficiently protected by current defence measures. This option does not significantly reduce the scale of economic losses arising from a major flood (only slightly less damages in relation to do minimum). However, it would improve public awareness of flooding issues within the catchment and it would lead to some reduction in flood damages since people are able to prepare.
Defend on-line/raise defences	Includes refurbishing the existing defences on their current alignment and/or raising the flood defences for anticipated climate change scenarios or to increase the standard of protection provided. This option implicates likely increase in downstream water levels, which may reduce the standard of protection and/or significant land-take to accommodate the predicted increase in defence level for flood defence embankments. In addition, it may potentially constrain working areas due to close proximity between flood defence and urban areas and there are no conservation or biodiversity benefits directly associated with this option. However, this option minimises the land take adjacent to the river, maximises protection to full FMUs and the public is likely to accept this option.
Managed realignment	Involves relocating flood defences away from the edge of the river channel. It provides opportunities to attenuating flood flows and hence reduce the risk of flooding to urban areas. There are also significant environmental benefits including the creation of new habitats as well as allowing the river to flow more naturally and hence encouraging habitat diversification. However, the public will oppose this option due to potential large agricultural and some isolated residential land take. This option may implicate large initial project costs due to land purchase and construction of realigned defences, but potential for reducing Agency flood defence expenditure in the long term.
Increased flood storage capacity	May involve the creation of new washland areas and/or increasing the size of existing flood storage sites to increase the standard of protection against flooding. Other measures may include: (i) washland creation; (ii) in-channel storage (IDBs); (iii) sustainable urban drainage systems (SUDS); and (iv) managed land-use techniques i.e. ploughing of fields. Significant environmental opportunities are likely to result from this option as well as, it will allow the river to operate more naturally by frequent inundation of the storage/wetland and encouraging habitat diversification.
Improve channel	May be achieved by dredging the river bed and raising and modifying obstructions, such as bridge structures. Other options include: (i) installation

Table 2.2 Summary of the generic options being considered in the Lower Don strategy study.

Options	Description
conveyance	of flood relief channels; (ii) removal of other in-channel obstructions; and (iii) flow diversion via bypass channels and installation of bypass culverts. The positive impacts of these options are the optimisation of channel flood flows at known constraint points. However, the material removed from the channel will have to be disposed off-site and this could be contaminated with heavy metals and other contaminants, and there may be significant loss of heritage value due to improvements in channel conveyance at Stainforth Bridge, which may be unacceptable to stakeholders.
Management of flood control structures	May involve changes in the control structures operating rules. The main control structures are the closing gates situated at the bottom of the River Went and Ea Beck, and they operate under the action of the tide or high fluvial flows. Positive impacts of this option include the fact that the River Went and Ea Beck will operate as flood storage channels during high tides. Negative impacts include the fact that maintenance is likely to be complex, there are health and safety concerns associated with operation and maintenance of structures and the gates are susceptible to vandalism.

3. Structuring the problem

This section intends to break down the problem into its component parts, identifying the set of impacts and associated criteria that will be used to make the decision. There was not enough background information to be able to complete an AST for high level screening (AST-FMDC-S) for the Lower Don strategy study. It was possible, however, to link the assessment criteria used in the original assessment with the assessment criteria used for the MCA-based approach, and in this way organise the flood problem.

The approach used in the strategy study for the Lower Don has some similarities with the approach used in the MCA-based methodology. The original appraisal for the Lower Don strategy uses the strategic objectives as the assessment criteria and these are fairly similar to the impact types and categories used in the MCA-based approach. In addition, the original appraisal uses a scoring approach to select a preferred strategic option.

Given the similarities, an attempt was made to use as much of the available information and transform it to use it in the MCA-based approach.

In order to start fitting the existing information into the MCA-based process it is necessary to link each of the strategic objectives and sub-objectives to one of the impact categories used in the assessment summary Table. Table 3.1, overleaf, illustrates these links. Some of the strategic objectives included sub-objectives that corresponded to different impact categories. For this reason the sub-objectives were separated out to be distributed among the impact categories.

For the impact categories ‘assets’, ‘land use’ and ‘availability and accessibility of services’ no suitable link/similarity was found with any of the objectives and/sub-objectives. From the information available it is reasonable to conclude that the different options will not have an impact on the availability and accessibility to services. In what concerns the impact on assets and land use these will most certainly occur and on the original strategy study they are covered under the economic appraisal.

For the remaining impact categories there are corresponding objectives and sub-objectives. These can be considered to be the intangible impacts of the appraisal, i.e. those that cannot be assessed in monetary terms.

Table 3.1: Links between the Lower Don strategic objectives and the MCA impact categories

MCA impact categories		Strategic objectives and sub-objectives	
Assets	Includes flood damages and/or losses relating to private and public property such as residential, industrial and/or commercial property, caravan parks, public sewage and water supply networks, pipelines, etc.		
Land use	Includes flood damages to land used for agricultural, industrial, urban, forestry, commercial fisheries purposes.		
Transport	Includes impacts to roads, bridges, railways and navigation.	**Ensure compatibility with transport and other infrastructure**	• maintain strategic communication and service links; • identify navigation opportunities; • consider impacts of future operations to avoid constrains.
Business development	Includes regeneration/development and competitiveness. Regeneration includes impacts on the creation of sustainable communities, i.e. economic development and development or maintenance of social cohesion. Competitiveness includes impacts to businesses (their costs, investment, market structure, etc.).	**Achieve balanced approach to all land uses and regeneration.**	• ensure that local businesses, rural economies and livelihoods remain viable.
Physical habitats	Includes impacts to terrestrial, aquatic and marine habitats and biodiversity, its conservation designations, and its flora and fauna.	**Protect and enhance biodiversity**	• ensure compatibility with nature conservation objectives at designated sites; • improve area, quality and distribution of BAP habitats; • improve numbers and distribution of BAP species; • restore natural river and floodplain habitats; • improve fisheries and reduce obstructions to fish movements.
Water quality	Includes impacts on biological and chemical quality of surface and groundwater water.	**Protect and enhance water, air and land quality.**	• maintain and improve quality standards • reduce contamination and the release of

Table 3.1: Links between the Lower Don strategic objectives and the MCA impact categories

MCA impact categories		Strategic objectives and sub-objectives	
			dangerous substances.
Water quantity	Includes impacts on the water levels and water supplies (such as drainage and run-off).	**Balance the needs of water users and improve river catchment management**	• ensure compatibility with Don and Rother Catchment Abstraction Management Strategy (CAMS); • encourage uptake of Sustainable Urban Drainage (SUDS); • influence rural land management to reduce run-off; • improve aquifer recharge.
Historic environment	Includes impacts on heritage, archaeological and geological features.	**Protect and enhance features of archaeological and heritage interest.**	• improve knowledge of sites/ features and their relevance; • prevent damage due to flood defence work.
Landscape and visual amenity	Includes impacts on the appearance of the land (its shape, colour, and particular features), its landscape designations as well as its agreeable nature.	**Protect and enhance landscape character/visual amenity.**	• consider landscape character objectives; • enhance quality of landscape character; • provide flood defences in keeping with their environs.
Natural Processes	Includes impacts on flow dynamics, sediment transport, geomorphology, etc.	**Promote the principles of sustainable development**	• promote natural flood plain functions.
Recreation	Includes impacts on the processes or means of entertainment. It includes angling, informal recreation (walking, sunbathing, picnicking, sitting, swimming, etc.) and formal recreation (sports and other activities that require specific equipment).	**Improve the quality of life in terms of amenity, recreation and access.**	• improve access and amenities for informal recreation; • create opportunities for informal recreation.
Health and safety	Includes impacts such as risk to life or serious injury, stress and anxiety (mental health and livelihood) and other health effects, such as those created during the construction phase of the project (noise and air pollution, for example).	**Ensure options are technically feasible in terms of reducing the flood risk.**	• ensure preferred generic options, policies and measures reduce flood risk within the catchment where appropriate.

Table 3.1: Links between the Lower Don strategic objectives and the MCA impact categories

MCA impact categories		Strategic objectives and sub-objectives	
Availability and accessibility of services	Includes impacts on availability and accessibility to public services such as education, housing, emergency and cleaning services, health, cultural facilities and other.		
Equity	Includes distribution impacts (consideration of interest of all groups of stakeholders), impacts on vulnerable groups (such as the elderly, children, etc.) and social tensions (rise of serious divisions and conflicts within the community).	**Achieve balanced approach to all land uses and regeneration.**	• avoid segregation of communities/social groups;
Sense of community	Includes impacts on the local community, level of satisfaction with neighbourhood, social networks and community expectations.	**Achieve balanced approach to all land uses and regeneration.**	• retain social fabric.
Policy integration	Includes impacts on pre-existing policies and programmes, such as planning and environmental policies, at all levels.	**Achieve balanced approach to all land uses and regeneration.**	• adopt and expand principles of South Yorkshire and North East Derbyshire Local Environment Agency Plan.
		Promote the principles of sustainable development.	• facilitate sustainable land use; • incorporate climate change effects; • facilitate sustainable use of materials.
		Ensure options are economically feasible.	• ensure preferred policies and measures for flood risk management are economically feasible by undertaking an initial economic appraisal.
		Consider stakeholder acceptability of flood risk management generic options, policies and measures.	• ensure early feedback from statutory consultees is considered during the option appraisal process; • evaluate likely stakeholder feedback to generic options, policies and measures.

Table 3.1: Links between the Lower Don strategic objectives and the MCA impact categories

MCA impact categories		Strategic objectives and sub-objectives	
		Reduce the risk of flooding to people, property and the environment taking account of social acceptability.	• improve defence standards where appropriate; • reduce the risk of embankment breach to an acceptable level; • improve flood warning services where appropriate; • control development in the flood plain; and • enhance flood storage where appropriate.

4. Assessment of impacts

A substantial part of the Lower Don catchment and adjoining areas contain relatively low-lying land with very little topographic variation. There is a very significant risk of flooding within these areas situated within watercourses. The available benefits must therefore be shared between the adjoining watercourses to avoid overestimation through double counting.

4.1 Monetary valuation of impacts

All of the following information was obtained from the Lower Don strategy study draft report (Atkins, 2004).

An indicative benefit-cost ratio has been calculated for each of the FMUs to determine whether future flood defence investment is worthwhile. This calculation was based on maximum available benefits, assuming asset write-off, and the total present value flood defence costs anticipated across the life of the strategy.

The Lower Don draft report states that the monetary assessment of impacts is an initial assessment and it is recognised that a more detailed economic appraisal will be carried out during the next project stages. Consideration will need to be given to some complex issues including defining flood inundation areas and associated flooding depths for different flooding scenarios. In addition, further hydraulic modelling and breach risk information will be required to enable a comprehensive appraisal to take place.

4.1.1 Write-off benefits

Write-off values of residential, industrial and agricultural assets were assessed during the appraisal of benefits. It has been assumed that a breach occurs in the first year of the strategy period and the flood management unit is completely inundated. This will result in abandonment of the flood management unit and all assets are consequently written-off.

Assets

Write-off values for residential properties were estimated using address point data examined using Map info software to determine the number of properties per post-code area within each flood management area. The average house price for each postcode was retrieved from the Land Registry website. A summary of the number of properties and overall property value per FMU is given in Table 4.1.

Table 4.1 Number of properties and write-off values for each FMU for the 'Do-nothing' option

FMU	Total number of properties	Overall residential properties value
1	9,743	£1,085,409,172
2	10,630	£1,332,261,824
3	795	£68,328,231
4	1,935	£152,467,126
5	1,312	£108,753,400

The number of industrial and commercial properties, i.e. Non Residential Properties (NRP), was estimated by manually checking the address point data and identifying addresses containing a reference to industrial and commercial organisations. Commercial properties such as banks and public houses were included in the analysis for residential properties.

Write-off values for NRPs were assessed using a realistic flooding time series and utilising the depth damage dataset for logistical warehouse premises contained in the Multi-Coloured Manual. An undiscounted damage value of £1,209 per m^2 was estimated. Table 4.2 illustrates the numbers and write-off value of NRPs identified for each FMU.

Table 4.2 Number of NRP and write-off values for each FMU for the 'Do-nothing' option

FMU	Number of NRPs	Overall NRP Value
1	22	£347,150,000
2	1	£251,931,000
3	0	-
4	0	-
5	26	£1,358,938,000

The write-off value for Keadby power station represents a significant proportion of the overall damages and has therefore been included in FMU 2.

Land use

A large proportion of the FMUs consist of varying grades of agricultural land that were classified in grades 1 to 5 and ungraded. In order to calculate the write-off value of agricultural land the guidance presented in the multicoloured manual was used. The valuation loss of 45% is applied to the prevailing agricultural land market prices arising as a result of permanent flood defence breach. Table 4.3 illustrates the write-off value of agricultural land for each FMU.

Table 4.3 Overall agricultural write-off values for each FMU for the Do Nothing option

FMU	Overall Agricultural Value
1	£15,866,000
2	£89,829,000
3	£14,194,000
4	£2,047,000
5	£1,476,000

Transport

Write-off of transportation assets (e.g. the M62 motorway) has not been included since the data is not readily available. However, this should not have a significant impact on the calculations because they are much smaller than the damages relative with the remaining assets.

4.1.2 Comments on the economic assessment

The information provided here for the economic assessment of impacts constitutes a wide summary of the information provided in the Lower Don strategy study draft report.

The economic assessment developed in the strategy study does not follow the guidance provided by Government on economic appraisal for flood and coastal defence. It represents a very high level assessment of the strategy and does not contain enough detailed information to allow for the MCA-based economic assessment of the case study.

Although it is not mentioned anywhere in the report, it seems that the practitioners decided to carry out the economic assessment only to the preferred option. The preferred option seems to fall from the scoring exercise undertaken previously. However, there is no explicit indication of which option is the preferred one (from the eight options being appraised). Also, the generic assessment of the impacts of options on the strategic objectives takes into consideration the whole of the Lower Don study area, whilst a preferred strategic solution is selected for each of the FMUs.

During the development of the case study it became apparent that it would be impossible to carry out a guidance driven economic assessment of the different options being appraised. For this reason, it was decided that this case study should not be continued.

4.2 Scoring of impacts

As stated in the previous Section, the Lower Don strategy study uses a scoring approach to assess each of the proposed options in relation to each of the strategic objectives and sub-objectives. This exercise is carried out prior to the economic assessment.

The strategy study developed a matrix approach in order to carry out a preliminary assessment. The matrix identifies the main impacts of the options and estimates the magnitude of both positive and negative impacts. The approach was chosen in order to ensure that each of the options has been assessed in a similar manner to provide a consistent approach. The scoring system employed uses positive and negative symbols to translate the magnitude of the effect of the option on the objective. The key to the scoring system used in the Lower Don strategy study is illustrated in Table 4.4. No further information is provided in the draft report (Atkins, 2004) about the underlying principles of the scoring exercise.

Table 4.4: Key to the scoring system used in the Lower Don strategy study

Impact significance	Original approach
Major negative	---
Moderate negative	--
Minor negative	-
Negligible impact	-/+
Minor positive	+
Moderate positive	++
Major positive	+++

There are several issues that arise with the implementation of such a scoring system.

This scoring system is very similar to the 'Likert Scale' system, one of the systems initially tried out on the Kelling Hard to Lowestoft SMP case study. Its main advantage in relation to other scoring systems is that it avoids the need to find numeric basis for assigning the scores. At a very high level appraisal (using ballpark information) this system may be useful in a preliminary analysis.

However, this type of scoring system has several significant disadvantages:

- because it is based on qualitative statements it increases the level of subjectivity of the scores. It is almost impossible to ensure that the definitions/key is being used in the same way for all impact categories. For example, 'major positive' always relates to the same level of additional benefit from one strategic objective to the next;
- it makes it difficult to maintain the transparency and auditability of the assessment as there is often no recordable basis for assigning one definition over another. In the Lower Don strategy study this is particularly

true since no justification is given to the assigned scores in the matrix or anywhere else in the main report; and

- it makes it difficult to respect the proportionality between the different options. For example, when major positive impact is recorded for two different options, it is assumed that these two impacts have the same magnitude, when often this is not the case. Although both options have major positive impacts, one may have a bigger major positive impact than the other and this fact is not respected by this type of scoring system.

Nevertheless, in order to continue the assessment, an attempt was made to transform the original scoring method into the scoring system being tested under the MCA-based methodology. The scoring system selected for this case study was the 'relative to 100' approach, for practical reasons. This transformation is presented in Table 4.5. It is important to note that the results from this scoring exercise should not be taken as absolute since they are based on a scoring system that is subjective and does not respect proportionality. In addition, the justification for the scores in the original assessment was not provided.

Table 4.5: Key to the scoring system used in the Lower Don strategy study

Impact significance	Original approach	MCA approach
Major negative	---	0
Moderate negative	--	25
Minor negative	-	40
Negligible impact	-/+	50
Minor positive	+	60
Moderate positive	++	75
Major positive	+++	100

The major positive and major negative impact categories score of 100 and 0, respectively. To the negligible impact definition a score of 50 was assigned, since it represents the middle of the scale.

The difference between moving from a negligible impact to a minor (positive or negative) and from a negligible impact to a moderate (positive or negative) is not a proportional one. It was considered that there is a bigger 'jump' between the negligible and moderate than between negligible and minor. For this reason:

- for the moderate positive impact significance a score of 75 was assigned;
- for the minor positive impact significance a score of 60 was assigned;
- for the minor negative impact significance a score of 40 was assigned; and
- for the moderate negative impact significance a score of 25 was assigned.

There were some strategic objectives for which none of the options scored the highest possible score. In these cases the option that scored the most was considered to be 100 and for the remaining options the scores were adjusted relative to this one. So for example, for the transport related objective, the

highest scoring options were option 5 and 6 (both with ‘moderate positive’). This means that in normal circumstances it would score 75, however this 75 was adjusted to 100 to reflect the fact that these were the highest scoring options. Options 4, 7 and 8 all scored ‘minor positive’ (or 60), which is 15 points different from ‘moderate positive’ (75), therefore these options were scored 85, and so on.

In addition, several strategic objectives and sub-objectives fell in to the policy integration impact category. In this case, each objective was considered as an impact sub-category with equal weight, which was scored. Once all the impact sub-categories had been scored, the scores were added up and adjusted so that the highest scoring option would score 100 and the others would score proportionally in relation to the best one.

The scoring classification given to the objective was assumed to be attributable to the sub-objectives.

5. Conclusions

One of the main aims of applying the MCA-based approach to the Lower Don strategy study was to test the methodology on a riverine high-level project. The idea was to examine whether the impact types and categories that constitute the ASTs were as suitable for river projects as they are for coastal projects as well as whether the scoring approach was as practicable to apply.

Although it was not possible to continue with this case study, it is believed that it achieved its purpose.

It is obvious from the information presented above that the impact types and categories are suitable to river projects. The decision criteria used in the original appraisal for the Lower Don (the strategic objectives) were based on the same sources of information as the impact categories used in the MCA-based approach and therefore were very easy to include in the assessment summary tables. The case study also shows that, although river and coastal projects may have significantly different natures, they can both be assessed using the flood management and coastal defence ASTs. The differences between these two types of projects will be reflected by the impact categories that will be relevant for the assessment. For example, water quantity is an impact category that is not usually relevant for a coastal problem, however it is fundamental for a river project.

Although it was not possible to apply the MCA-based scoring system (ChaRT) to this case, a rough reasoning over the case study shows that if the information usually collected for this type of project were available it would enable the implementation of the ChaRT system.

6. References

Atkins (2004): Lower Don strategy study - draft report, report produced for the Environment Agency North East Region, March 2004.

FCDPAG 2. Flood and Coastal Defence Appraisal Guidance – Strategic Planning and Appraisal, London HMSO