



Flood and Coastal Defence Project Appraisal Guidance

FCDPAG3 Economic Appraisal

**Supplementary Note to Operating Authorities
March 2003**

REVISIONS TO ECONOMIC APPRAISAL PROCEDURES ARISING FROM THE NEW HM TREASURY “GREEN BOOK”

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TREASURY “GREEN BOOK”**

1. Introduction

1.1 HM Treasury has recently published new guidance on *Appraisal and Evaluation in Central Government* – the “Green Book”¹. It is mandatory that all flood and coastal defence schemes formally approved after 1 April 2003 should be appraised in the light of this new guidance. This note sets out some specific changes, which will need to be considered for all scheme submissions, and the process for doing this depending on what stage in the appraisal and approvals process individual applications have reached.

1.2 This note also gives early notice of some longer-term changes to appraisal guidance which Defra are considering ahead of a full revision of FCDPAG3 towards the end of 2003.

1.3 **Annex 1** gives the background to the Treasury’s review of the Green Book and why changes are being made. **Annex 2** provides data necessary to implement new guidance on “Optimism Bias” (see below). **Annex 3** gives some worked examples of the changes applying to flood and coastal defence appraisals from 1 April 2003.

1.4 Changes from 1 April relate to discount rates, appraisal periods and the treatment of project risk (Optimism Bias). In most cases these should be straightforward to implement but in the first instance any query should be discussed with your own economic adviser. If further advice is then required please contact your Defra Regional Engineer’s office.

2. Process for implementing changes to appraisal from 1 April 2003

2.1 The changes from 1 April apply differently to three different categories of application, depending on what stage they have reached in the appraisal and approvals process:

- **Scheme applications formally approved on or before 17 March 2003.**: No action necessary - existing Green Book guidance applies;
- **Emerging strategy or scheme plans for which economic analysis is not complete as at 17 March 2003:** New guidance to apply in full. On submission to Defra, economic appraisal should be fully compliant with new guidance as at Section 3 below;
- **Strategies or schemes for which appraisal is complete, but which have not been formally approved by Defra as at 17 March 2003:** Operating Authorities and Defra need to satisfy themselves that recommendations would not be changed as a result of

¹ www.hm-treasury.gov.uk/greenbook

applying the new guidance. Defra is willing to be flexible on how this is approached, but some guidelines are given in Section 4 below.

3. Changes in guidance from 1 April 2003 (to apply in full to appraisals not yet completed)

Discount rates

3.1 The test discount rate becomes 3.5% for years 0-30, 3.0% for years 31-75, and 2.5% thereafter. Until Defra issues revised FCDPAG3 spreadsheet templates, the use of 3.5% for all years will be acceptable (though authorities may re-work the spreadsheets for themselves if they wish).

Appraisal periods

3.2 The appraisal period should reflect the physical life (with maintenance) of the longest-lived asset under consideration for a scheme. The presumption is that for most conventional schemes, involving major earthworks, concrete or masonry structures a 100-year timeframe will be appropriate. There is now an increased need to consider the true length of life of assets in appraisal, because the use of lower discount rates gives increased weight to costs and benefits accruing in the more distant future. In particular, operations and maintenance expenditure will carry more weight in appraisal under the new guidance, and estimates should be made as robustly as possible given current information.

To illustrate the potential impact of the new discount rates, the table below shows the present value (PV), in £k, of a benefit (or cost) of £1,000 per year for the whole appraisal period.

Appraisal period	All at 6% p.a. (£k)	New discount rates (£k)	Increase in total Present Value
50 years	16.8	24.7	47%
75 years	17.5	28.1	61%
100 years	17.6	29.9	70%

Therefore, whereas using the old discount rate the 'error margin' caused by ignoring annual costs or benefits between years 51 and 100 is only some 5%, with the new rate structure this increases to over 20%.

Treatment of project risk ("Optimism Bias")

3.3 There is a widely recognised tendency for appraisers of all kinds of projects to be overly optimistic in their early assessment of project costs, time scales and benefits, when these are compared with final outturn values. This is termed "Optimism Bias". Under old Green Book guidance, Optimism Bias was taken into account in a generalised way through a percentage premium embodied in the test discount rate. HM Treasury have now "unbundled" this issue from the discount rate (which hence declines from 6% to 3.5%), and henceforth require an explicit consideration of Optimism Bias through i) the application of suitable uplifts

to early best estimates of project costs, and ii) sensitivity analysis of predicted benefits and project time scales.

Best estimates

The 'best estimate' for any project should be the appraiser's assessment of the most likely outturn costs of the project including, for example, all labour, materials, supervision, land purchase, compensation, access costs and contractors' overheads associated with both temporary and permanent works required and all long-term costs associated with its operation and maintenance. Where the judgement of the estimator is that additional sums are likely to be required for particular areas of work, for example dealing with poor ground conditions, these should be included but general contingencies should be estimated as part of the process of deriving the optimism bias adjustment. All elements of the estimate should be based on experience of projects of similar character and should recognise the likely difficulties involved in carrying out works in particular circumstances, for example, the high cost of working in confined spaces or within, or adjacent to, private properties in urban areas. For further information see FCDPAG3.

3.4 Sensitivity analysis of benefits and time scales is already best practice for flood and coastal defence projects. However, the new Green Book approach to Optimism Bias in cost estimates requires a strengthened approach. Defra has carried out initial analysis of both project account data and a report by Mott MacDonald to Treasury on Optimism Bias in public project costs². This analysis informs the interim best practice guidance set out below for flood and coastal defence strategy and scheme costs:

- Strategy costs (initial feasibility stage)

At this stage it is assumed that no detailed design has been carried out and therefore cost estimates are based on broad assumptions about the scope and nature of the work.

Step 1: For each option, identify best estimates of all capital, operating and maintenance costs given current information.

Step 2: Take a starting value for Optimism Bias of **60%** of total Present Value costs (including capital, operating and maintenance costs over the whole life of the option). This percentage reflects the current view of average cost uplift from strategy/pre-feasibility stage to final account in flood and coastal defence.

Step 3: Study Annex 2 to this note which sets out the current view of the key components of risk which make up the overall 60% factor. Assess whether the contributions of these components should be higher or lower for the particular situation under consideration. Where demonstrable action has been taken to minimise individual risks, a case can be made to reduce the relevant component(s). Conversely, where the project may be more risky than average in certain areas (perhaps because of innovation), then the relevant risk component contributions should be increased. In the absence of evidence either way, the default risk component percentages should be left unchanged.

² Review of large public procurement in the UK, Mott MacDonald, July 2002. Available at www.hm-treasury.gov.uk/greenbook

Step 4: Rework the overall Optimism Bias factor based on any revisions to risk components. Apply the revised Optimism Bias factor as a percentage uplift to total Present Value costs (in place of any contingency estimate).

As an alternative to Steps 3 and 4 in the Environment Agency: Where the full EA recommended “Monte Carlo”-type risk valuation approach has been undertaken for all costs then the 95% confidence level estimate should be used to derive the Optimism Bias factor. Where necessary, the above approach should be used for all present value costs that are not included in the risk approach (e.g. long-term maintenance). These adjustments should then be added to the 95% confidence risk-based results.

- Scheme costs (detailed design stage)

To reach this stage it is assumed that appropriate site investigations and detailed design of the main works have been carried out so that major cost items are based on detailed assessments of works required from substantially complete working drawings and specifications.

Proceed as for strategies, but use a starting Optimism Bias factor of **30%** and the relevant risk component guidelines in Annex 2.

3.5 Optimism Bias adjustments outlined above take the place of the current “contingency” estimates at strategy and scheme level for appraisal purposes, however they will not be formally included in the sums on which “agreement” of strategies, and “approval” of schemes are based. Current guidance in FCDPAG3 should be followed for the derivation of appropriate contingencies for inclusion in approved sums, generally these will not exceed 20% of the grant eligible total or the 50% confidence limit in risk based derivations.

4. Cases where appraisals are now complete but formal approval has not yet been given by Defra

4.1 In an ideal world, the treatment of such cases would be for economic appraisals to be fully and quickly reworked before approval is considered (or reconsidered). However, this is unlikely to be practical or desirable for many applications at this stage of the process.

4.2 Nevertheless, Authorities should still satisfy themselves that decisions recommended by analysis conducted under “old” Green Book guidance are not likely to change under the new guidance. For the **discount rate change** and new consideration of **Optimism Bias**, this can be examined through simple sensitivity analysis where this has not already been conducted. We would advise that the new approach to **appraisal periods** only needs to be considered where one or more options assessed under a strategy or scheme have the following characteristics:

- The difference between current appraisal period and true physical asset life is more than 25 years,
and
- Significant costs (e.g. maintenance, operations including beach recharge etc.) are likely to be incurred in the time between current appraisal period and true physical asset life.

4.3 Defra will also need to be satisfied that the new guidance does not change the recommendations of appraisals conducted under old guidance but not yet formally approved. Regional Engineers will liaise with Operating Authorities individually for schemes that are currently being processed by the Department.

5. Changes to appraisal practice over the longer term

5.1 The above constitutes interim guidance pending a full review of FCDPAG3 *Economic Appraisal*, scheduled to be completed towards the end of 2003. Other changes to appraisal practice which are being investigated as part of this review include the following:

- **Distributional adjustment:** The new Green Book has established the principle of attaching more weight to costs and benefits which accrue to low-income groups (and less weight to those falling on high-income groups) as a result of public interventions. The possible application of such adjustments to benefit-cost analysis in flood and coastal defence is being investigated.
- **Risk aversion:** The new Green Book also suggests one way of accounting for risk aversion in benefit-cost analysis, by estimating a cost of variability of outcomes. The applicability of this to flood and coastal defence appraisal is being looked at, alongside other methods of accounting for possible risk aversion in the at-risk population.
- **Optimism bias:** Further analysis of available Defra and EA data on the progression of project costs and time scales will be carried out, with a view to providing more detailed advice on Optimism Bias for the revised version of FCDPAG3.

Flood Management Division and
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Annex 1

What is the “Green Book” and why has it been revised?

For many years, HM Treasury has issued guidance to government departments on how to appraise ex-ante all policies, programmes and projects, and how to evaluate them ex-post. This guidance is known as the “Green Book – Appraisal and Evaluation in Central Government”. It concentrates on economic appraisal in the form of benefit-cost analysis.

The Green Book is binding on government departments and executive agencies. In practice it is also tailored for use in devolved administrations. The Green Book is also used widely in regional agencies and local government, especially for proposals that require funding from central government.

The Green Book was last revised in 1997, since which time things have moved on. The Office of Government Commerce has been created; PFI and PPP have grown significantly as procurement routes; and interest rates have fallen and remained low. Most of all, Government now has a central concern to improve delivery of public services. Getting the most out of public spending is of the essence. Meanwhile, the NAO has criticised project appraisals in the past. The appraisal methodology has to keep in step with these changes, criticisms and aspirations.

The new Green Book complements the programme to modernise infrastructure set out in the Spending Review, and aims to address the needs for greater long-termism in government appraisal and for improved appraisal skills.

The main changes in the new Green Book are:

- increased emphasis on the importance of valuing the benefits of interventions;
- greater transparency for risk, including “unbundling” optimism bias from the discount rate;
- methods to better take into account the long-term and distributional impacts of actions.

Annex 2

Interim Optimism Bias data for flood and coastal defence strategy and scheme costs

Starting (upper bound) Optimism Bias factor for	Strategy costs (pre-feasibility stage):	60%
“ “ “ “ “ “ “ “	Scheme costs (detailed design stage):	30%

Evidence for above factors:

Strategy factor: Informed by average for “standard” and “non-standard” civil engineering projects in “Review of Large Public Procurement in the UK”, Mott MacDonald 2002, and consultation with Defra Regional Engineers.

Scheme factor: Informed by initial analysis of Defra account data which suggests Optimism Bias at scheme approval stage is broadly half that at strategy stage.

Risk components contributing to above factors (%, summing to 100 – see next page for definitions)		Average % for FCD projects
Procurement	Late contractor involvement in design	1
	Dispute and claims occurred	11
	Other	1
Project-specific	Design complexity	4
	Degree of innovation	4
	Environmental impact	13
	Other	9
Client specific	Inadequacy of the business case	23
	Funding availability	2
	Project management team	1
	Poor project intelligence	8
Environment	Public relations	5
	Site characteristics	4
External influences	Economic	5
	Legislation/regulations	4
	Technology	4
	Other	1

Evidence for above components:

These are based on the average components for “standard” and “non-standard” civil engineering presented in the Mott MacDonald report, rounded to the nearest whole number (taking a view as to which factors should be rounded up and which down in the flood and coastal defence context).

- The risk components (except for those described “Other”) may be reduced for individual strategies or schemes if demonstrable action to minimise risks has been taken, or other evidence is provided that risks are not applicable to the degree indicated. In which case, the revised sum of risk components should be divided by 100 and multiplied by either 60 or 30 to obtain the new Optimism Bias factor.

Example of Optimism Bias approach: After an assessment of risk components, the “environmental impact” component for a strategy plan is halved (i.e. reduced by 6.5). New OB factor equals:

$$(100-6.5)/100 \times 60 = 56$$

So the best estimate of Present Value strategy costs is increased by 56%, with this adjustment applying to operating and maintenance expenditure as well as capital expenditure.

Definitions of risk components

Procurement	Late contractor involvement in design	Late involvement of the contractor in the design leads to redesign or problems during construction
	Dispute and claims occurred	Disputes and claims occur where no mechanisms exist to manage effectively adversarial relationships between project stakeholders
	Other	Other factors that relate to procurement which affect the final project cost
Project-specific	Design complexity	The complexity of design (including requirements, specifications and detailed design) requires significant management, impacting on final project costs
	Degree of innovation	The degree of innovation required due to the nature of the project requires unproven methods to be used
	Environmental impact	The project has a major impact on its adjacent area leading to objection from neighbours and the general public
	Other	Other project-specific factors which affect the final project cost
Client specific	Inadequacy of Business Case	The project scope changes as a result of the poor quality of requirement specifications and inadequate project scope definition
	Funding availability	Project delays or changes in scope occur as a result of the availability of funding (e.g. departmental budget spent or insufficient contingency funds)
	Project management team	The project management team's capabilities and/or experience impact on final project costs
	Poor project intelligence	The quality of initial project intelligence (e.g. preliminary site investigation, user requirements surveys etc.) impacts on the occurrence of unforeseen problems and costs
Environment	Public relations	A high level of effort is required to address public concern about the project, which impacts on the final project cost
	Site characteristics	The characteristics of the proposed environment for the project are highly sensitive to the project's environmental impacts (e.g. Greenfield site with badger setts, or contaminated brownfield site)
External influences	Economic	The project costs are sensitive to economic influences such as higher-than-expected construction cost inflation, oil price shocks etc.
	Legislation/regulations	The project costs are sensitive to legislation and regulation changes, e.g. health and safety and building regulations
	Technology	The project costs are sensitive to technological advancements, e.g. the effects of obsolescence.
	Other	Other external influencing factors which affect the final project cost

Annex 3

Example applications of the revised guidance

This annex summarises the results of applying the new Green Book changes to two of the worked examples presented in FCDPAG3. For full descriptions of the problems and assumptions made, please see the original publication, available from Defra publications or at <http://www.defra.gov.uk/envIRON/fcd/pubs/pagn/fcdpag3/default.htm>. Access to the full reworked spreadsheets that have been used to generate these examples will be available at <http://www.defra.gov.uk/envIRON/fcd/pubs/pagn/>.

It should be noted that these are a simplified examples that do not, for example, consider factors such as the influence of climate change on future failure probabilities that should be taken into account in a real appraisal situation.

Example 1 (Example 2 from Annex A3 of FCDPAG3)

This is a coastal erosion problem with different options for reducing the probability of future failure of the coastal defence system.

In the do-nothing case the existing seawall deteriorates with increased risk of failure over the next five years leading to onset of erosion and loss of properties over the eight years following the initial failure.

The three 'do-something' options considered are:

Option 2 - Minimum investment, maintain existing seawall

Option 3 - Phased replacement of the existing seawall by section

Option 4 - Immediate replacement of entire seawall

Of these, option 2 assumes that regular expenditure is required throughout the appraisal period and it has a higher risk of failure, options 2 and 3 assume that the replacement cycle has to be repeated after 50 years.

A summary of the results of the economic analysis is given in Table A3.1.

For comparison, the results from the FCDPAG3 example 2, using a 6% discount rate and a 50-year evaluation period are shown in Table A3.2.

Comparison of the two results shows that:

- The effect of the reduced discount rate on the combined cash flows of seawall failure leading to initiation of erosion and the subsequent period of property loss is to increase do nothing damages by almost £1m (15%).
- Similarly, damages are increased for do something options due to both the reduced discount rate and the increased appraisal period.
- Costs are increased for all options due to the longer-term appraisal and, for options 3 and 4, the assumed need for replacements after year 50.
- Using the assumptions of this example the preferred option is still option 2 with no economic justification for adopting either of the more expensive options. In practice the result would clearly depend on accurate assessment of structure life, repair and replacement costs and failure probabilities for the different states of the structure over the whole appraisal period and it would be necessary to have a clear understanding of the sensitivity of the result to the assumptions made in these areas.

Table A3.1 Summary results for FCDPAG3 Example 2 using New Green Book adjustments

	Costs and benefits £m			
	No Project	Option 2	Option 3	Option 4
PV costs from estimates	0.00	1.57	8.45	10.06
Optimism bias adjustment		0.47	2.54	3.02
Total PV Costs for appraisal PVc		2.04	10.99	13.07
PV damage PVd	7.63	1.75	0.43	0.28
PV damage avoided		5.89	7.20	7.36
Total PV benefits PVb		5.89	7.20	7.36
Net Present Value NPV		3.85	-3.79	-5.72
Average benefit/cost ratio		2.89	0.66	0.56
Incremental benefit/cost ratio			0.15	0.07

Table A3.2 Summary of results from FCDPAG3 Example 2, 6% discount rate, 50-year appraisal

	Costs and benefits £m			
	No Project	Option 2	Option 3	Option 4
PV costs PVc	-	0.96	6.28	8.40
PV damage PVd	6.60	0.96	0.25	0.13
PV damage avoided		5.64	6.35	6.47
Total PV benefits PVb		5.64	6.35	6.47
Net Present Value NPV		4.68	0.07	1.93
Average benefit/cost ratio		5.86	1.01	0.77
Incremental benefit/cost ratio			0.13	0.06

Example 2 (Example 3 from Annex A3 of FCDPAG3)

This is a river flood management problem with properties susceptible to flooding from both overtopping of the embankment and breaching due to potential embankment failure.

In the 'do-nothing' case there is a high probability of write off of properties due to failure of the embankments within the next few years.

The three 'do-something' options considered are:

Option 2: Flood storage + breach probability reduced to 1 in 20 years

Option 3: Flood storage + breach probability reduced to 1 in 50 years

Option 4: Flood storage + breach probability reduced to 1 in 100 years

A summary of the results of the economic analysis is given in Table A3.3.

For comparison, the results from the FCDPAG3 example 3, using a 6% discount rate and a 50-year evaluation period are shown in Table A3.4.

Comparison of the two results shows that:

- Do nothing damages are not significantly increased by the Green Book changes as properties are assumed written off relatively early in the appraisal period.
- Do something damages are increased due to the longer appraisal period and the greater significance of events in the future.
- Costs for all options are increased due to the reduced discount rate, the increased appraisal period and the adjustments for Optimism Bias.

- Overall Option 2 is still the economically preferred option but it would have a reduced benefit cost ratio. Since it would cost over £900k extra to achieve less than £1,100k additional benefits by choosing option 2 rather than option 3 (as reflected in the incremental benefit/cost ratio), this increase in standard is only marginally beneficial and difficult to justify in economic terms.

Table A3.3 Summary results for FCDPAG3 Example 3 using New Green Book adjustments

	Costs and benefits £k			
	No Project	Option 2	Option 3	Option 4
PV costs from estimates	-	2,508	3,210	4,872
Optimism bias adjustment	-	752	963	1,462
Total PV Costs for appraisal PVc	-	3,260	4,174	6,334
PV damage PVd	8,105	1,897	825	468
PV damage avoided		6,208	7,280	7,637
Total PV benefits PVb		6,208	7,280	7,637
Net Present Value NPV		2,948	3,106	1,303
Average benefit/cost ratio		1.90	1.74	1.21
Incremental benefit/cost ratio			1.17	0.17

Table A3.4 Summary of results from FCDPAG3 Example 3, 6% discount rate, 50-year appraisal

	Costs and benefits £k			
	No Project	Option 2	Option 3	Option 4
PV costs PVc	-	1,836	2,337	3,730
PV damage PVd	7,130	1,061	462	262
PV damage avoided		6,069	6,669	6,869
Total PV benefits PVb		6,069	6,669	6,869
Net Present Value NPV		4,234	4,332	3,138
Average benefit/cost ratio		3.31	2.85	1.84
Incremental benefit/cost ratio			1.20	0.14