The Economic and Social Research Institute

Trickle or treat - Water quality, investment and pricing

Friday 26th November 2004
8:45 am – 1:00 pm

Investment in Water Infrastructure - Lessons From Economic Analysis of Projects

John Lawlor and Colm McCarthy, DKM Economic Consultants

Introduction

The substantial increase in public investment in Ireland since the early 1990s has been reviewed in a number of ex-ante, mid-term and ex-post studies, many of them carried out by ESRI-led teams. The most recent is FitzGerald et al (2003), the mid-term review of the current National Development Plan 2000-2006. A recurring theme in these evaluation documents is the importance of project selection and prioritisation. Ex-ante analyses of costs and benefits across the full public capital programme are invariably recommended, at least by economists!

In late 2003/early 2004, DKM along with the ESRI and Aquavarra Research carried out an *Ex Post Economic Evaluation of Cohesion-Funded Water Supply & Waste Water Projects,* on behalf of the Department of the Environment, Heritage & Local Government[1]. The assignment consisted of two elements:

(1) drawing up a methodology for carrying out *ex post* Cost Benefit Analysis (CBA) on water investments under the Cohesion Fund, and

(2) applying this methodology to 14 schemes involving roughly 50 individual projects, which fell into three main headings – water supply, waste water treatment and water conservation.

This paper briefly describes the development of a CBA methodology and the schemes and projects involved, summarises the results of the CBAs, and sets out the lessons we see flowing from the analysis.

Development of a CBA Methodology

This was informed by a number of pre-existing documents, in particular detailed guidance produced by the UK Government and the EU Commission[2].

With most CBAs the difficult part is the valuation of the benefits, as the costs are in general more identifiable, particularly in this case, as the analysis was carried out *ex post*[3]. Valuation

[1] The evaluation was in compliance with EU Council Regulation (EC) No. 1164/94 (as amended), which states that "Member States shall evaluate the manner in which they (the projects) have been carried out and the potential and actual impact of their implementation in order to assess whether the original objectives can be, or have been, achieved." (Article 13.4).

[2] 'Guide to Cost-Benefit Analysis of Investment Projects' Evaluation Unit, DG Regional Policy, European Commission, 2001 edition.

UK Environmental Agency, Assessment of Benefits for Water Quality and Water Resources Schemes in the PR04 Environment Programme.

[3] Valuing costs can also be problematic where they are environmental or non-market, but in general these were not significant in the current context.

of benefits is particularly problematic where they are environmental and external to the marketplace[4]. Assessing these benefits involved three steps:

1. Identifying the Impacts

The important issue is not how much pollutants are discharged from treatment plants, but what improvements are generated in the receiving waters. Before and After data on water quality is needed, as well as confidence that the improvement is due to the investment in question.

In many cases, we found that information was inadequate, or it indicated that the investment had no impact. In a number of cases, we understand from EPA and Local Authority personnel, it is too early to identify the environmental impacts, as these may take several years to become apparent.

2. Quantifying Benefits

Improved water quality can lead to a number of environmental benefits, including –

- Improved capacity for fish stocks and the potential benefits for angling;
- Benefits for those engaged in other water-based activities such as swimming and boating;
- Improved general amenity – visual impact, odour, etc.
- Other wildlife benefits, e.g. greater capacity to support aquatic birds and animals.

3. Valuing Benefits

We are concerned here with the values that humans put on the environmental benefits. Information is needed on two levels: (i) how many people get value from the benefit, as users and non-users[5] and (ii) how much they value it. One can carry out surveys to ascertain both, but these are significant undertakings and have rarely been carried out in Ireland. As a

[4] Valuation of much of the "internal" benefits, in the form of improved water services, also proved problematic, since most of these benefits are either unpriced or under-priced in the Irish market. We were forced to use valuations based on water prices in the UK market.

[5] We can consider benefits under two headings – user benefits and non-user benefits. The first of these is self-explanatory, referring to those who directly experience the benefits (e.g. anglers, swimmers, boaters). The second relates to people who may never visit the area, but value the fact that the improvements have been achieved. The more unique or significant the environmental characteristics involved, the higher these values are likely to be. For example, an individual might value improvements in the water quality of the Shannon, without ever actually visiting it.

fall-back, “Benefits Transfer”, the application of valuations arrived at elsewhere, can be used, though this is less than ideal, and one can argue whether these valuations are suitable in the Irish context. We found also that Benefits Transfer was not applicable in valuing user benefits, as it could not be used to generate credible estimates of user numbers.

Hence in our CBAs we were in many cases unable to quantify environmental impacts, and where we were able to do so, were only able to put a value on non-user environmental benefits.

Application of the Methodology

A list of the schemes and project covered, and their details, are given in the Appendix. Fourteen schemes comprising 60 projects were included. CBAs were carried out at the level of project, and aggregated to the level of scheme. Some of the projects were only Cohesion-Funded as to planning, and CBAs were not carried out on these. CBAs were also not carried out on the Water Resources Management projects, since the output of these were reports on major water systems (Liffey/Boyne/Suir and Loughs Derg and Ree), and hence had no physical output that was amenable to CBA. CBAs were carried out on 51 individual projects in total.

A difficulty arose in applying the methodology to waste water projects. In most cases the main benefits of these schemes were environmental in nature[6], and as discussed in many cases we were unable to satisfactorily value them. The Appendix indicates to what degree benefits were valued for these projects.

The results of our CBAs are summarised in Table 1. Waste water projects are dealt with separately, because of the difficulties with valuing benefits. The table gives capital cost, Net Present Value (NPV), the Internal Rate of Return (IRR), and the discounted Benefit-Cost Ratio (BCR). The discount rate used, which represents the required rate of return, was 5%.

Table 1: Summary of Projects and CBA Results

Project Type	Number of Projects	Capital Cost VAT Excl. (€'000)	NPV (€'000)	IRR Real	BCR
Water Treatment	4	9,574	32,691	22.4%	3.00
Water Distribution	6	37,509	119,621	16.2%	3.67
Water Treatment & Distribution	5	77,062	47,966	5.2%	1.36
Sub-total Water Supply Projects	15	124,145	200,278	9.8%	2.18
Waste Water Treatment	20	101,244 }			
Sewerage & Waste Water Treatment	5	134,463 }	See separate discussion		

[6] In many cases, an important rationale in undertaking the project was compliance with the UWWTD, but this benefit is not amenable to inclusion in CBA.

Sewerage	4	13,019 }			
Sub-total Waste Water projects	29	248,726 }			
Water Conservation	12	72,341	302,485	21.7%	3.16
Resource Mgt.	4	8,184	No CBAs carried out		
Total	**60**	**453,395**	**371,816**		
Number on which CBAs carried out	51				

Notes:

1. Capital Cost is Cohesion Funded element, undiscounted, VAT exclusive. Where better information was not available, the VAT exclusive figure was taken to be the VAT inclusive figure divided by 1.125.
2. IRR is the average of the individual IRRs, weighted by capital cost.
3. BCR is the average of the individual discounted BCRs, weighted by capital cost.

Roughly one quarter of the projects and the capital cost related to **water supply**. By-and-large these generated greater than the required return on investment, with an average IRR of 9.8%. The rates of return varied significantly between the three sub-types listed, but in a number of cases the split is somewhat artificial: schemes can be divided into a number of individual projects or stages, but significant expenditure can be included in one project, the benefit of which is mainly felt in a subsequent project. This was the case in the instances where water supply projects returned a negative NPV. In many cases projects enabled expansion of development (especially housebuilding), which was highly worthwhile in terms of generating internal benefits.

Water conservation projects accounted for 20% of the total number and 16% of the total capital cost. These projects were almost invariably highly worthwhile, with a relatively low capital cost and an average IRR of 21.7%. Given the highly positive results, the question might be asked - why weren't these projects undertaken years ago? Does it point to weaknesses in the structures (notably financial structures) of the water industry in Ireland?

Waste Water Projects

As Table 1 indicates, almost half the projects considered related to waste water, and these accounted for 55% of the capital cost. In total there were 29 projects, under six schemes, i.e.:

- Two lake schemes - Lough Derg and Lough Ree,
- Three river schemes - Boyne, Liffey and Clonmel (Suir), and
- One coastal/estuarine scheme – Dundalk.

The Appendix gives the results of the CBA exercise on these projects, and also highlights to what degree benefits were valued. Of the 29 projects in the schemes covered, two had no CBAs carried out, as they had only been funded as to planning. Of the remaining 27 projects, 16 generated internal benefits, which we valued. As for environmental benefits, the following summarises our efforts at valuation:

	# of Projects
Environmental improvements quantified and valued (non-user only)	8
Environmental improvements but data insufficient to enable valuation	6
Data indicate no improvements to date	11
No data available on environmental improvements	2
Total	27

Note that only non-user environmental benefits were valued - user benefits could not be valued due to lack of information.

Below is a short discussion on each scheme:

Lough Derg

While on an overall basis the Lough Derg scheme met the 5% rate of return, the individual projects varied significantly. Four projects – Roscrea, Nenagh, Ballinasloe and Monksland – generated positive returns, Roscrea and Monksland because they enabled increased development, and Nenagh and Ballinasloe due to environmental benefits. The other four projects – Athlone, Tullamore, Portumna and Moate – generated negative returns. For Athlone, we could value environmental benefits, while for Portumna and Moate we could value internal benefits but they were not sufficient to cover the costs. For Tullamore, Portumna and Moate, the available information indicated no environmental improvement to date.

Lough Ree

In the Lough Ree scheme there were seven projects subjected to CBA, and all of them generated negative returns. We could identify and value internal benefits in six of the projects. For three of them environmental benefits were experienced but there was insufficient data to value them; in another three the data to date indicated no improvement, in one case there was no data available.

River Boyne

This involved three projects, including new treatment plants in Navan and Trim. All three generated negative returns. Internal benefits were valued for the two

treatment plants, and environmental benefits were identified for both, but could only be valued for the Navan plant.

River Liffey

On an overall basis this scheme generated a positive return. The scheme involved five projects that were subject to CBA, including treatment plants at Osberstown and Leixlip, and sewerage schemes at Kilcullen, Prosperous and Celbridge. We were able to value internal and external benefits for the two treatment plants, and external benefits for the Celbridge project. Available data indicated no environmental improvement to date arising from the Kilcullen and Prosperous projects.

Clonmel

Despite being able to value both internal and external benefits for this scheme, it generated a negative return.

Dundalk

Dundalk was the single biggest scheme analysed, costing €65 million VAT exclusive, more than the National and Dublin Water Conservation schemes combined. We were able to value internal benefits, arising from new users of waste water services. However, while there were indications of environmental improvements the data were insufficient to enable us to put a value on these. On the basis of our valuations, the scheme generated a highly negative return.

Left at that, most of the waste water schemes appear to have been poor value. However we are being unfair to them, as we have been unable to fully value their environmental benefits, due to lack of information. Where we could value these, we were only able to value non-user benefits, and it is reasonable to hypothesise that user benefits would also be substantial. In many cases, also, it appears that the environmental benefits may not become fully apparent for a number of years.

So our results for waste water projects are less than ideal. We carried out one additional exercise on these projects, whereby we compared their negative NPV with the population of likely potential users, and calculated the requisite level of Willingness To Pay (WTP) in order for the project to be worthwhile. We estimated the population of potential users by taking the population of the environs of the affected water body, per the Census of Population 2002. We than made an assumption as to what percentage of users would be local, and what percentage would be from further afield. We reduced the required negative NPV figure by the percentage of non-local users. The formula is thus:

Required WTP per Capita = (Negative NPV x %age of Users who are local) ÷ Local Population

The assumed percentage of local users varied with how well-known or substantial the water body is: the better known, the lower the percentage of local users. For Lough Ree and Lough Derg we used 50%, as these are well-known tourist attractions. For the River Boyne and Clonmel (River Suir) we used 75%, while for Dundalk, which has a well-known bird sanctuary, we used two-thirds. One can of course argue about these percentages, but this is meant to be an illustrative exercise, to give a broad indication of the level of money involved.

The results of this exercise is given in Table 2 overleaf (the River Liffey scheme is not included as it generated a positive return on its main elements).

As can be seen, the level of user environmental benefits required to make the projects worthwhile vary greatly. We cannot be prescriptive about these results, but can make the following points:

- Within the Lough Derg and Lough Ree schemes, there is a wide variation in required WTP levels, which raises questions about the prioritisation of the constituent projects.

- Boyne and Clonmel are comparable to the degree that they are both river schemes affecting reasonably large urban areas. On the basis of our estimations the Boyne scheme appears to have been more worthwhile, though one might argue about the level of potentially affected population included.

Table 2: Required WTP to Make Waste Water Projects Worthwhile

Project	Capital Cost	NPV	Population of Potential Local Users			Required WTP €	
	€'000	€'000	Definition	# Persons	# Households	per capita	per Household
Lough Derg							
Athlone MD	4,552	-3,793	Athlone town, and No. 1 & 2 Rural Areas	36,019	13,194	43	118
Tullamore	1,204	-2,490	Tullamore town & Rural Area	30,038	11,003	41	113
Birr	389	-641	Birr town and No.1 Rural Area	19,035	6,973	17	46
Portumna	9,878	-10,486	Portumna Rural Area	6,082	2,228	862	2,353
Moate	4,288	-2,418	Athlone No.1 Rural Area	16,205	5,936	75	204
Lough Ree							
Ballyjamesduff	2,413	-326	Castlerahan rural area	6,423	2,353	25	69
Granard	4,640	-5,073	Granard No.1 rural area	7,387	2,706	343	937
Ballymahon	3,100	-4,464	Ballymahon rural area	5,350	1,960	417	1,139
Longford	270	-1,002	Longford town and Longford Rural Area	18,331	6,715	27	75
Roscommon	6,811	-8,352	Roscommon Rural Area	18,441	6,755	226	618
Ballaghadereen	9,902	-9,731	Castlereagh Rural Area	13,927	5,101	349	954
Boyle	4,913	-1,865	Boyle No. 1 & 2 Rural Areas	13,111	4,803	71	194
River Boyne (note)	39,567	-15,689	Navan and Trim towns and environs, Slane village and Drogheda Borough	57,154	20,936	206	562
Clonmel (R. Suir)	22,181	-20,053	Clonmel Borough and No. 1 & 2 rural areas	23,565	8,632	638	1,742
Dundalk	65,396	-62,178	Dundalk town and environs	32,505	11,907	1,275	3,481

Note: Navan and Trim combined are treated as a single project here, as they both impact on the same water body, and the environmental improvements might not be separately identifiable. The population of Drogheda is included, as the Boyne is Drogheda's main source of raw water supply. Leighsbrook culvert not included. We estimate that, based on land opened up for development by the Leighsbrook project being developed for housing, the required value per housing unit to make the project worthwhile would be €3,500.

Sources: CSO Census of Population 2002, Volume 1.

- The Dundalk scheme is the most expensive considered, and the only coastal/estuarine one. It also has the largest calculated shortfall. It might be seen as a "classic" UWWTD-driven investment, in that it represents secondary treatment for the outfall of an urban area, which heretofore had been released to a coastal/estuarine environment without treatment. Our results indicate that on purely environmental grounds this scheme might not have been considered a priority[7].

Conclusions & Lessons

- Our study undertook *ex post* Cost Benefit Analysis on over 50 projects in 14 Cohesion-Funded schemes, falling into three categories: water supply, waste water treatment and water conservation.

- There is a wide range in the results. Some projects appear to have delivered adequate returns, but others do not.

- Identifying and valuing costs was straightforward from an *ex post* point of view, but this raises a question about hurdle rates of return. Since slippage in cost is a major project risk, *ex ante* hurdle rates should be higher to reflect this. We do not discuss cost estimates vs. out-turn in this paper, but the project report documents cost over-runs on each project. There were a lot of cost over-runs, some small, some substantial.

- Identifying and valuing benefits, even *ex post,* is more difficult. These can be divided into internal and external (or environmental) benefits. Internal benefits were for the most part capable of valuation, although the fact that water services in Ireland are not properly priced meant we were forced to use UK values in many cases. External benefits were difficult to identify and value, due to lack of data, and in a number of cases available data indicated that no environmental improvements had occurred to date.

- Most of the benefits of water supply and water conservation projects were internal, while most of those related to waste water projects were external.

- We found that most water supply and water conservation projects were worthwhile, the latter particularly so.

- Waste water projects appeared to be less worthwhile, with most projects generating a negative return, but lack of environmental data (and hence values) make it difficult to be definitive. Six schemes were considered: Loughs Derg and Ree, Rivers Liffey, Boyne and Suir (Clonmel), and Dundalk. The Liffey scheme generated a positive return, as did Lough Derg, though there was a wide variation in returns on the latter's individual projects.

[7] Dundalk is also unusual in that the majority of the load is industrial: the PE of the plant is 179,000, compared with a human population of 32,500. Industry made a capital contribution of €3.8 million, and is expected to pay roughly €1 million per annum in payments towards the operating costs of the plant. We treated this annual payment as being the internal benefit to industry of the treatment plant.

- Of the 27 waste water projects considered, the following summarises our attempts to identify and value environmental benefits. Note that data limitations meant that only non-user environmental benefits were valued:

	# of Projects
Environmental improvements quantified and valued (non-user only)	8
Environmental improvements but data insufficient to enable valuation	6
Data indicate no improvements to date	11
No data available on environmental improvements	2
Total	**27**

- In view of the uncertainties, we undertook an additional exercise on the waste water projects (excluding those in the Liffey scheme), in which we estimated how highly the local population would have to value the environmental benefits for the projects to be worthwhile. The results, which should be considered illustrative, are summarised as follows (full details in Table 2):

  - Within the Lough Derg and Lough Ree schemes, there is a wide variation in required valuation levels, which raises questions about the prioritisation of the constituent projects.

  - The Boyne scheme appears to have been more worthwhile than Clonmel, though one might argue about the level of potentially affected population included under each scheme.

  - The Dundalk scheme is the most expensive considered, and the only coastal/estuarine one. It also has the largest calculated shortfall, and would require implausibly high valuations of environmental benefits by the local population. This indicates that on purely environmental grounds this scheme might not have been considered a priority.

- This study highlighted a serious lack of Before and After environmental data in relation particularly to waste water investments. These fall into two categories:

  (1) in many cases, data on water quality downstream of the new/upgraded plants were inadequate to quantify the environmental impact; and

  (2) in all cases there was a lack of data on the numbers of people using the water bodies in question, and how they valued any change that occurred.

  On the face of it, it is difficult to understand this lack of data, considering the level of investment that has occurred in this and other programmes. Without this data it is not possible to assess accurately whether the investments were worthwhile.

- The water investment programme includes what might be termed optional and mandated elements: Ireland was bound over this period by various EU Directives, notably the Urban Waste Water Directive, which prescribes certain treatment levels. Cost-benefit analysis is strictly speaking irrelevant where compliance is mandatory. But our results suggest that projects designed to comply with Directives may not be achieving hurdle rates of return, which raises questions about the Directives themselves. Specifically, our results suggest that better projects, within the water sector, may have to be foregone in order to provide resources for lower-yielding but mandatory schemes.

- The timetabling (prioritisation) of schemes can be greatly aided by cost/benefit analysis, which can in principle identify the projects, within a set of possibilities all of which pass the hurdle test, which programme delivers the benefits soonest. If say 10 projects all cost €100m, and all offer more than the hurdle IRR, it is not a matter of indifference which is undertaken first. CBA can identify the highest-yielding programme.

- While measurement problems remain and data deficiencies need to be addressed, there may already be enough raw material available to justify consideration of a full *ex ante* appraisal regime in water investment.

- A final issue is hurdle rates of return. The Department of Finance has for many years suggested a real rate of 5% for public investment. But projects are heterogeneous, and project risks will differ enormously across sectors. In the regulation of public utilities, the permitted return on the regulated asset base is normally struck at a rate meant to cover the cost of capital, with due allowance for equity risk premium, gearing and the risk-free real rate. Regulators in Ireland, the United Kingdom and elsewhere have tended to come up with figures higher than 5% real. In the UK, Ofwat, the water industry regulator, has proposed 7.3% pre-tax for the current review. In Ireland, regulators have been using rates arrived at through computing the Weighted Average Cost of Capital, and allowing for taxation where relevant. This approach adds an *estimate* of the equity risk premium to an *estimate* of the risk-free real rate, non-observable in the absence of a market in index-linked Government debt, and allows for gearing. Clearly this is not an exact science. Real rates currently in use in Ireland by CER (the energy regulator) and CAR (the aviation regulator) are

Electricity Industry: 6.5% for Networks, 7% for generation assets;

Gas Transmission and Distribution: 5.74% for both;

Airports: 6%.

In the United Kingdom real rates vary by sector, but all exceed 5%.

- For the water industry in Ireland, a hurdle rate of 5% seems to us to be on the low side in current circumstances. The widespread incidence of cost-overrun argues for, other things equal, a higher *ex ante* rate, and we recommend that the Department of Finance review its suggested hurdle rate.

Appendix: List of Schemes and Projects

Scheme	Project	Project Type	Capital Cost VAT Excl. (€'000)	NPV (€'000)	IRR	BCR	Environmental Benefits?[1]
Lough Mask Regional Water Supply	Claremorris Sewerage Scheme	Sewerage & Waste Water Treatment	9,503	-12,457	N/A	0.25	A
Scheme (Stage 3)	Tourmakeady Sludge Dewatering	Water Treatment	2,715	21,861	46.8%	5.78	
Sub-total			**12,218**	**9,404**	**9.7%**	**1.45**	
Lough Derg Water Quality Improvement	Ballinasloe Sewerage	Waste Water Treatment	548	2,160	24.2%	2.41	A
	Monksland Sewerage	Waste Water Treatment	6,343	689	5.5%	1.07	C*
	Athlone MD	Waste Water Treatment	4,552	-3,793	-1.1%	0.30	A
	Roscrea Sewerage Scheme	Waste Water Treatment	5,786	14,370	10.2%	1.82	C*
	Tullamore Sewerage Scheme	Waste Water Treatment	1,204	-2,490	N/A	-	C
	Birr Sewerage Scheme	Waste Water Treatment	389	-641	-16.6%	-	C
	Nenagh Sewerage Scheme	Waste Water Treatment	412	2,597	63.2%	5.26	A
	Portumna Sewerage Scheme	Waste Water Treatment	9,878	-10,486	-4.0%	0.12	C*
	Clara Sewerage Scheme	Waste Water Treatment	434	No CBA carried out			
	Moate	Sewerage & Waste Water Treatment	4,288	-2,418	1.9%	0.65	C*
	Catchment Management System	Resource Mgt. (with Lough Ree)	2,534	No CBA carried out			
Sub-total			**36,369**	**-12**	**5.0%**	**1.00**	
Monaghan WSS	Crosses	Water Treatment & Distribution	13,921	-394	4.9%	0.98	
	Togan	Water Treatment	1,719	6,535	25.3%	3.98	
Sub-total			**15,641**	**6,141**	**6.8%**	**1.24**	

Scheme	Project	Project Type	Capital Cost VAT Excl. (€'000)	NPV (€'000)	IRR	BCR	Environmental Benefits?[1]
Lough Gill RWS Scheme	Sligo & Environs Stg 1 & 2	Water Treatment & Distribution	24,303	7,535	6.2%	1.13	
	Foxes Den)						
	Cairnshill Refurbishment	Water Treatment & Distribution	3,775	16,748	24.1%	2.56	
	Kilsellagh Treatment Works	Water Treatment	540	No CBA carried out			
	Kilsellagh Dam Safety	Water Distribution	142	No CBA carried out			
	Farrancardy Reservoir	Water Distribution	72	No CBA carried out			
Sub-total			**28,832**	**24,283**	**8.2%**	**1.35**	
North Tipperary RWS Scheme	Nenagh	Water Distribution	5,844	859	5.7%	1.11	
	Roscrea	Water Treatment	4,599	4,294	9.5%	1.34	
Sub-total			**10,444**	**5,154**	**5.7%**	**1.11**	
Dundalk Sewerage Scheme		Sewerage & Waste Water Treatment	**65,396**	**-62,178**	**-2.3%**	**0.41**	B*
River Boyne Catchment	Trim	Waste Water Treatment	6,472	-2,791	2.7%	0.72	B*
	Navan Sewerage Augmentation	Sewerage & Waste Water Treatment	33,095	-12,898	3.1%	0.78	A*
	Navan - Leighsbrook Culvert	Sewerage	4,295	-4,402	-4.7%	-	N/A
	3 Rivers Monitoring & Mgt System	Resource Mgt.	1,902	No CBA carried out			
Sub-total			**45,764**	**-20,091**	**2.6%**	**0.73**	

Scheme	Project	Project Type	Capital Cost VAT Excl. (€'000)	NPV (€'000)	IRR	BCR	Environmental Benefits?[1]
River Liffey WWT (Stage 1)	Osberstown	Waste Water Treatment	21,282	14,465	8.5%	1.28	A*
	Kilcullen	Sewerage	3,918	-5,131	-4.6%	-	C
	Prosperous	Sewerage	4,361	-4,493	-4.4%	-	C
	Upper Liffey Valley RSS		**29,560**	**4,841**	**5.9%**	**1.08**	
	Leixlip	Waste Water Treatment	11,772	6,848	7.4%	1.20	A*
	Celbridge	Sewerage	446	2,969	25.7%	6.60	A
	Lower Liffey Valley RSS		**12,218**	**9,817**	**8.3%**	**1.28**	
	3 Rivers Monitoring & Mgt System	Resource Mgt.	1,214	No CBA carried out			
Sub-total			**42,993**	**14,657**	**6.8%**	**1.15**	
Tuam Regional Water Supply	Stage 1 Contracts 1-4	Water Treatment & Distribution	27,346	-27,115	-4.0%	0.25	
	Stage 2 - Athenry Extension	Water Distribution	9,728	-6,280	-0.1%	0.37	
	Stage 3	Water Distribution	17,310	97,826	27.0%	5.93	
	Galway City Water Conservation	Water Conservation	6,462	10,459	16.5%	1.88	
Sub-total			**60,846**	**74,889**	**11.9%**	**1.96**	
Clonmel Main Drainage Scheme	Stages I, II, III, IV	Sewerage & Waste Water Treatment	**22,181**	**-20,053**	**1.2%**	**0.56**	A*

Scheme	Project	Project Type	Capital Cost VAT Excl. (€'000)	NPV (€'000)	IRR	BCR	Environmental Benefits?[1]
National Water Conservation	Cork	Water Conservation	2,292	2,842	11.2%	1.44	
	Limerick	Water Conservation	1,481	12,805	48.4%	4.49	
	Wexford	Water Conservation	3,595	-413	3.0%	0.91	
	Athlone	Water Conservation	288	699	19.3%	1.81	
	East Meath	Water Conservation	1,050	600	8.9%	1.32	
	Longford	Water Conservation	622	5,215	72.4%	4.12	
	Kilkenny	Water Conservation	1,227	3,861	21.1%	2.44	
	Clonmel	Water Conservation	244	16,542	357.2%	15.86	
	Donegal	Water Conservation	3,005	4,666	15.4%	1.88	
Sub-total			**13,804**	**46,817**	**25.3%**	**2.65**	
Dublin Region Water Conservation		Water Conservation	**48,407**	**246,492**	**23.2%**	**3.78**	
Waterford City & Environs Water Supply	City	Water Treatment & Distribution	7,718	51,193	25.4%	6.07	
	County	Water Distribution	4,412	27,216	24.1%	5.61	
	Water Conservation	Water Conservation	3,667	-1,283	2.8%	0.78	
Sub-total			**15,797**	**77,126**	**21.3%**	**4.52**	

Scheme	Project	Project Type	Capital Cost VAT Excl. (€'000)	NPV (€'000)	IRR	BCR	Environmental Benefits?[1]
Lough Ree Catchment Protection	Ballyjamesduff Sewerage Scheme	Waste Water Treatment	2,413	-326	4.1%	0.90	B*
Scheme Stage 1	Granard Sewerage Scheme	Waste Water Treatment	4,640	-5,073	-4.1%	0.26	D*
	Ballymahon Sewerage Scheme	Waste Water Treatment	3,100	-4,464	-10.4%	0.13	B*
	Longford Sewerage Treatment	Waste Water Treatment	270	-1,002	n/a	-	B
	Roscommon Sewerage Scheme	Waste Water Treatment	6,811	-8,352	-4.4%	0.25	C*
	Ballaghadereen Sewerage Scheme	Waste Water Treatment	9,902	-9,731	-3.3%	0.17	C*
	Boyle Sewerage Scheme	Waste Water Treatment	4,913	-1,865	3.1%	0.77	C*
	Sludge Disposal	Waste Water Treatment	121	No CBA carried out			
	Catchment Management System	Resource Mgt.	2,534	No CBA carried out			
Sub-total			**34,704**	**-30,813**	**-2.2%**	**0.35**	
Grand Total			**453,395**	**371,816**			

Note: Capital Cost is Cohesion Funded element only; undiscounted total, VAT exclusive. Where better information was not available, the VAT exclusive figure was taken to be the VAT inclusive figure divided by 1.125.

[1] Relates to wastewater projects only.

A. Environmental improvements quantified and valued.

B. Environmental improvements experienced but data to date insufficient to enable valuation.

C. Data indicate no improvements to date.

D. No data available on environmental improvements.

* Internal benefits also included and valued.