The Naas Motorway Bypass – A Cost Benefit Analysis

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THE NAAS MOTORWAY BYPASS — A COST BENEFIT ANALYSIS

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Abstract

The paper examines the Naas Motorway Bypass which cost £16m at 1983 prices. Twelve thousand vehicles a day using the bypass save over 10 minutes between 8 am and 8 pm and 6 minutes at other times. Five thousand vehicles a day using the present route through Naas also benefit by saving 4 minutes due to reduced congestion in the town. In addition to time savings, the bypass reduces accidents and fuel costs. Ninety-one per cent of the benefits accrue in time savings. The internal rate of return on the project is estimated at 20.51 per cent, assuming 2 per cent annual traffic and income growth. The sensitivity tests of the results show that even with zero growth in incomes and traffic for twenty years, a high proportion of leisure time savings with zero value and no increase in the value of fuel savings the project would have an internal rate of return which meets the test discount rate used by the Department of Finance.

The environmental aspects of the bypass are positive in terms of noise and smoke and lead pollution reduction. The impact on farm severence and natural amenities on the motorway route has been mitigated by several design features of the bypass.

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Introduction

The Road Development Plan for the 1980s proposed the expenditure of £1,072m (at 1978 prices) on the Irish road system over this decade. In 1983, major improvements to roads cost £48m. The total cost of improvements in respect of works in progress in 1983 was £268m according to the Department of Finance report on Comprehensive Public Expenditure Programmes.

The low rate of return on investment in the Public Capital Programme has been adversely commented upon by economists. In this paper we apply cost benefit analysis to a major project in an important area of public investment.

The Project

The Naas Motorway Bypass cost £16m at 1983 prices. This includes the construction of the motorway, four public road bridges and approach roads, two interchanges, an accommodation bridge for farmers, an underpass and a bridge over the town branch of the Grand Canal.

Naas is the junction point of the national primary routes N7 (Cork/ Limerick) and N9 (Waterford). The Naas Motorway Bypass will remove from the town through traffic on the N7. The bypass route lies to the west of the town.

The Benefits from Highway Investments

Studies of highway investments have quantified three main benefits: time savings, accident reduction, and vehicle cost savings. Shadow prices are imputed for these and projections are made of their values over the life of the project. The internal rate of return on the project is the rate which equates the present values of the streams of benefits and costs. This can then be compared with the test discount rate set by the Government for public sector projects.

In Britain, the computer programme COBA is used in the above way to evaluate trunk road investments. Following criticisms from environmental groups the Advisory Committee on Trunk Road Assessment was established in 1976 to comment on COBA "taking account both of economic and environmental factors". The committee's report, known as the Leitch Report, proposed the addition of environmental impact statements to give a wider view of a project in addition to the items quantified in COBA. Several environmental studies of the Naas bypass were prepared. These are reviewed later in this paper.

Valuing Time and Accident Cost Savings

Time savings allow further activities to be engaged in. When working time is saved, more goods and services can be produced with the labour released. These savings are valued at the cost to the employer of hiring labour. Employers are assumed to hire labour until it is known the cost of doing so equals the marginal revenue product of the employee.

The wage cost as an indicator of the value of working time has been shown by Harrison and Quarmby (1969) to be subject to a number of qualifications. It ignores labour market imperfections, the possibility that road-using enterprises may not be able to convert time savings into resource savings, resources may not have alternative uses, and that in some cases travel time may be used productively.

The haulage market is, however, competitive since firms may substitute own vehicles for hired haulage. Fleischer (1962) and Hanning and McFarland (1963) found that firms were able, after adjustments to schedules, to attain the full benefits from highway improvements by economising on fleet and labour costs.

Monopolistic power in labour markets is limited for the groups which account for the bulk of working time travel. These groups include professional drivers, salesmen, commercial travellers, travelling sales engineers and mechanics. While some travel time on other modes may be used for productive purposes this is unlikely to apply to road travel.

The case for valuing leisure and work time at the same rate is that the traveller is indifferent between work and leisure. Where the disutility attached to work is greater than to travel, leisure time savings are valued at less than the wage rate. If, for example, the disutility attached to travel is half that attached to work, leisure time savings would be valued at half work time savings.

Empirical studies in Britain indicate that the value of non-working time is approximately 25 per cent of working time values. These studies are based on modal choices where the respondents choose between faster expensive modes thus trading off time against other costs. Barrett (1982) contains a summary of some of these studies.

In this paper we follow the British practice in regard to both work and leisure time savings. However, we test the impact of changing these shadow prices on the rate of return on the project in a number of sensitivity tests.

Accident Costs

The cost of injuries is estimated from hospital and other medical data and from the loss of output while the patient is undergoing treatment. In the case of fatalities we cannot establish the accident cost to the victim. This is the loss of utility from being alive. The four measures of loss which have been used are, therefore, imperfect.

The gross output approach measures the discounted value of the expected future earnings of the victim. The net output approach deducts from this consumption. The shadow price approach derives an implicit value of life where deaths are increased or decreased by public policy. The insurance method seeks to measure the value a person sets on his life from the sum for which he is insured and the probability of his being killed in a particular activity.

The output measures are based on Gross National Product as the sole criterion for economic performance. It does not include factors such as grief, suffering, and loss of utility from being alive. The shadow price approach may yield vastly differing estimates of the value of life derived from different programmes. The insurance method measures the victim's concern for his family and dependants.

The fatal accident costs used in the paper are taken from COBA. They are based on the loss of output of the victim with consumption included as part of the loss of utility from loss of life for the victim. An allowance is also made to cover the costs of pain, grief, and suffering. Society devotes resources to the saving of life and the avoidance of injury, even though such expenditure cannot be justified on the basis of lost output from the victims.

In this paper we estimate that the bypass will reduce accidents but the accident savings will be relatively small in relation to the total benefits from the project.

Two earlier studies evaluated road investments in the area of the Naas bypass. O'Keefe (1962) estimated that the time savings, accident cost reductions, and vehicle cost reductions for the Naas dual carriageway yielded a benefit-cost ratio of 1.02 with an annual average daily traffic of 6,000 vehicles. Traffic now exceeds 26,000 vehicles. Feeney (1976) estimated that either a roundabout or a flyover at the junction of the Naas bypass and the north access road to the town would return benefits in excess of costs.

The Present Pattern of Traffic through Naas

Table 1 shows the 1982 traffic pattern on the national primary routes through Naas. Seventy-one per cent of traffic moves between 08.00 and 20.00 hours. The busiest hour is from 18.00 but traffic is heavy from 10.00 to 20.00 hours.

TABLE 1: Estimated Traffic Pattern at Naas in 1982

Hour from:	Share of Flow (%)
08.00	2.7
09.00	4.2
10.00	5.5
11.00	6.8
12.00	6.1
13.00	5.5
14.00	5.1
15.00	7.1
16.00	6.2
17.00	6.8
18.00	8.0
19.00	6.9
Total of above	71.0
20.00—08.00	29.0
	100.0

Source: McCarthy and Partners; Naas Traffic Study for 1000 hours to 1900 hours. Kildare County Council for other hours.

TABLE 2: Estimated Traffic Times by Hour of Day without Bypass

Hour	Journey Time (minutes)	Share of daily traffic
10.00 - 11.00	11.00	5.5
11.00 - 11.30	12.75	6.8
14.00 - 15.00	14.75	5.1
16.00 - 16.30	13.50	3.1
16.30 - 17.00	17.00	3.1
17.00 - 17.30	24.50	6.8
17.30 - 18.00	15.00	8.0
18.30 - 19.00	11.50	6.0
Weighted average	15.08	45.30

Source: McCarthy and Partners, Naas Traffic Study, 1971. (Based on 41 observations.)

In estimating the average speed of traffic during the period 08.00 to 20.00 hours we have 41 estimates of journey times from Monread, at the Dublin end of the bypass, to Ladytown which is one mile from the southern end of the bypass. We assume that the latter section is travelled at 40 mph. The times shown in Table 2 for travel on the route to be bypassed are the sum of observed times for the town section and 1.5 minutes for the remaining mile to the motorway.

The weighted average of the journey times in Table 2 is 15.08 minutes. We assume that this time is representative of all travel between 08.00 and 20.00 and use this in calculating the time savings in Table 3. We refer to this as peak traffic and to the remainder as off-peak traffic.

On the N7 route it is estimated that off-peak journey times are 10.90 minutes. This comprises 40 mph on the southern mile, 30 mph on the 2 miles at the Dublin side of Naas and 20 mph on the 1.8 miles at the centre of Naas.

The average speed assumed on the motorway is 60 mph. This may be conservative as the maximum permitted speed on motorways is 70 mph and there have been pressures to raise this to as high as 85 mph. The bypass design provides stopping sight distance for 75 mph for its entire length.

Time Savings

Nineteen thousand vehicles used the N7 and N9 routes through Naas daily and carried almost 31,000 people. Twelve thousand vehicles use the bypass on the N7 while 5,000 on the N9 benefit from reduced traffic congestion in the centre of Naas, between 08.00 and 20.00.

Traffic through Naas between 08.00 and 20.00 accounts for 71 per cent of the daily total. Table 3 shows that this category has savings of 10.28 minutes on the N7 while the 29 per cent travelling between 20.00 and 08.00 enjoy time savings of 6.1 minutes. In the case of N9 traffic the savings are 4.18 minutes between 8 am and 8 pm. At the off-peak periods, no time savings are assumed for this group.

TABLE 3: Journey Times through Naas with and without Naas Bypass (minutes)

		With Bypass	Without Bypass	Saving	Vehicles
N7	08.00 to 20.00	4.80	15.08	10.28	8,520
N7	20.00 to 08.00	4.80	10.90	6.10	3,480
N9	08.00 to 20.00	10.90	15.08	4.18	4,970
N9	20.00 to 08.00	10.90	10.90	0.00	2,930
					19,000

TABLE 4: Estimated Time Savings from the Naas Bypass, 1983

Category	Number per day	Time Saved (hours) per day	Value of Time £ per day	Annual Savings from Bypass (£000)
Car driver at work	5,548	630.6	3.362	774.0
Car passenger at work	1,102	125.3	2.196	133.4
Car driver non-work	8,512	967.5	0.725	256.0
Car passenger non-work	7,410	842.3	0.725	223.0
Goods vehicle occupants	6,251	710.5	2.464	639.0
Bus passengers	1,995	226.8	0.725	60.0
Bus driver	133	15.1	2.699	14.9
	30,951	3,518.1		2,100.3

In Table 4, we estimate the number of people travelling in the 19,000 vehicles by category of occupant using the occupancy factors from COBA and the time savings for each group. Just under 31,000 people will save 3,518 hours per day due to the bypass.

We estimate also that the annual value of these time savings in 1983 would have been £2.0m. This is estimated by taking the British values of time savings and reducing them to 56 per cent of the British figure to take account of the income differential in sterling between the two countries. They are then stated in Irish currency at mid-1983 exchange rates.

There are a number of sources of possible understatement of the value of time savings in these estimates. The individual time savings are based on a 1971 traffic survey. The valuation of these time savings is based on the difference between Irish and British incomes per head for the population as a whole rather than income differences per vehicle occupant. Our estimates do not include any benefits for N9 traffic in the off-peak period and local traffic in Naas. Both can be expected to gain from the removal of through traffic by the bypass.

Accident Cost Savings

Accident data prepared by An Foras Forbartha show that in the thirteen years to 1980 there were seventeen deaths and 143 serious injuries in road accidents in Naas. The population of Naas in 1971 was 7,739 and the highest accident rate for towns of this size was Killarney (population 7,724) which had 20 fatalities and 201 serious injuries while the lowest was Mallow (population 6,609) with three fatalities and 99 serious injuries.

The contribution of the bypass to road safety is the reduction in traffic in the town centre and its transfer to the motorway. Accident rates are lower on motorways than on undivided highways because the central median and flyovers reduce head-on and junction accidents.

Motorway Accidents

The probability of an accident on British motorways is 0.15 per million vehicle kilometres. There are 0.052 deaths per accident and 0.394 serious injuries per accident. The COBA motorway accident rates are thus 0.0078 deaths and 0.0591 serious injuries per million vehicle kilometres. The bypass is 8 kilometres and with an annual average daily traffic initially of 12,000 vehicles will generate 35.04 million vehicle kilometres of traffic per year with 0.273 deaths and 2.071 serious injuries.

We deduct from this accident figure the accident rate for 12,000 vehicles a day on the existing route. Daily traffic through the Naas section of the N7 grew from 9,165 to 18,918 between 1968 and 1981. The sum of the annual average

TABLE 5: Estimated Costs per Accident, Ireland, 1983 (£IR)

Accident	Urban	Rural	Motorway
Fatal	127,977	142,942	150,017
Serious	6,594	12,290	12,897

Source: adapted from COBA.

daily traffic figures for the thirteen years was 165,523 vehicles. During this period there were seventeen fatal and 143 serious injury accidents. The same accident rates for an average annual daily traffic volume of 12,000 imply 1.23 fatal and 10.37 serious accidents per year.

In Naas at present rates, 12,000 vehicles a day would cause 1.23 fatal and 10.37 serious injury accidents a year. At the costs per urban accident in Table 5 above this is an annual cost of £225,791. On the motorway route there will be 0.273 fatal and 2.07 serious injury accidents. At the cost per motorway accident in the above table these accidents will cost £67,652. The annual saving from diverting the traffic from Naas to the motorway in lower accidents will therefore be £158,139. While Naas has a relatively good safety record compared to other towns of its size in Ireland, British motorway accident rates imply that the number of accidents will be further reduced on the bypass. The accident rate reduction will more than compensate for the higher average cost per accident on motorways than in urban areas. The higher cost per accident on motorways is due to the greater severity of impact.

Savings in Fuel Consumption

The third quantified benefit from highway investment in COBA is fuel saving. The bypass substitutes a section of motorway with an average speed of 60 mph at all times for a route comprising three sections which have lower peak and off-peak speeds.

The Appendix gives estimates of the average fuel consumption per vehicle for each section in peak and off-peak periods and shows the average fuel consumption for the pre-bypass route at 2,892 gallons of petrol and 1,596 gallons of diesel per day. The fuel consumption estimates are based on the speeds used in the section on time savings.

The 12,000 vehicles which use the motorway were assumed in the section on time savings to have an average speed of 60 mph. The consumption of these vehicles will be 1,904 gallons of petrol and 974 gallons of diesel per day.

The 7,000 vehicles remaining on the old route to reach the N9 will have average speeds throughout the day now attained only in the off-peak periods. The fuel consumption for the N9 traffic, based on estimates in the Appendix for off-peak consumption, is as follows, cars: 798 gallons, light goods: 118 gallons and diesel: 546 gallons.

TABLE 6: Total Fuel Consumption per day in Naas with and without Bypass (gallons) and Value of Annual Savings

	Petrol	Diesel
Without bypass	2,892	1,596
With bypass	2,820	1,520
Savings due to bypass	72	76
Resource cost per gallon (p)	118	131
Annual Saving (£)	31,010	36,339

We must now combine the fuel consumption data on the bypass and for traffic remaining on the N9 and compare this with the current fuel consumption by the through traffic at Naas. This is summarised in Table 6. Fuel

TABLE 7: Time Stream of Benefits and Costs of Naas Bypass with 20.51 per cent Discount Rate (2% traffic growth and income growth assumed)

	Time (£'000)	Accident (£'000)	Fuel (£'000)	Total Benefit (£'000)	Costs (£'000)
1983	2100.3	158.1	67.3	2325.7	16012.0
1984	1813.3	136.5	57.0	2006.7	10.0
1985	1565.5	117.8	48.2	1731.6	8.3
1986	1351.6	101.7	40.8	1494.1	6.9
1987	1166.9	87.8	34.5	1289.2	5.7
1988	1007.4	75.8	29.2	1112.5	4.7
1989	869.7	65.5	24.7	960.0	3.9
1990	750.9	56.5	20.9	828.4	3.3
1991	648.3	48.8	17.7	714.8	2.7
1992	559.7	42.1	15.0	616.8	2.2
1993	483.2	36.4	12.7	532.3	1.9
1994	417.2	31.4	10.8	459.3	1.5
1995	360.2	27.1	9.1	396.1	2.6
1996	310.9	23.4	7.7	342.1	2.1
1997	268.5	20.2	6.5	295.2	1.8
1998	231.8	17.4	5.5	254.7	1.5
1999	200.1	15.1	4.7	219.8	1.2
2000	172.8	13.0	4.0	189.7	1.0
2001	149.1	11.2	3.3	163.7	0.8
2002	128.8	9.7	2.8	141.3	0.7
Totals	14556.0	1095.7	422.6	16074.3	16074.7

Note: Year begins: October 1st. Values are at 1983 prices. Fuel prices are assumed fixed in real terms.

TABLE 8: Sensitivity Test Results on Rate of return on Naas Bypass

Test	Title	Sensitivity Test Assumptions	Rate of Return (%)
1	Basic	2% traffic growth, 2% income growth, fixed fuel price	20.51
2	Basic + fuel price rise	2% traffic growth, 2% income growth, 2% fuel price growth	20.56
3	Zero value leisure	2% traffic growth, 2% income growth, fixed fuel price, zero value for leisure time	15.06
4	Zero growth 25% leisure	Zero traffic and income growth, 25% rate applied to 83% of cars in valuing time savings	12.75
5	Zero growth Zero leisure	Zero growth in traffic and incomes, Zero value for leisure time savings applied to 83% of cars	6.84
6	High Time	Basic assumptions with time savings increased 25%	25.16
7	Low Time	Basic assumptions with time savings decreased 25%	15.87
8	High Accident Value	Basic assumptions with accident costs increased 25%	20.86
9	Low Accident Value	Basic assumptions with accident costs decreased 25%	20.16

savings are small compared to the total benefits from the bypass. The savings estimated in Table 6 are conservative since they do not take into account the extra consumption of fuel by vehicles accelerating and decelerating in the congested pre-bypass traffic conditions.

Summary of Costs and Benefits

Table 7 shows that the internal rate of return on the Naas bypass is 20.51 per cent assuming a 2 per cent annual growth in traffic and national income over a 20 year project life. Time savings account for 90.6 per cent of the benefits. Accidents cost savings and fuel savings account for 6.8 per cent and 2.6 per cent of the benefits respectively.

In Table 8 we show the sensitivity of the basic rate of return to changes in the benefits from the bypass. Since time accounts for an estimated 90.6 per cent of the benefits,the internal rate of return is most sensitive to changes in the time values used. The time sensitivity tests are tests 3 to 7 inclusive.

Test 3 attributes zero value to the non-work time savings due to the bypass. Table 4 shows that 58 per cent of those who benefit from the bypass save leisure rather than work time. The basic rate includes these savings at 25 per cent of the work rate. A zero value lowers the return to 15.06 per cent.

Tests 4 and 5 assume zero traffic and income growth. They increase the non-work share of car journeys on the bypass to 83 per cent, an increase of 25 percentage points over Tests 1 to 3 and 6 to 9 inclusive. Test 4 applies the 25 per cent value for leisure time savings while Test 5 uses the zero rate. Tests 6 and 7 increase and decrease the values of time in the basic test by 25 per cent. The rate of return is highly sensitive to these changes.

Tests 8 and 9 change the accident costs by 25 per cent but this makes minimal impact on the rate of return since these savings account for 6.8 per cent of the benefits from the bypass. Fuel savings account for only 2.6 per cent of the benefits. Test 2 shows that an annual rise of 2 per cent in real fuel prices makes minimal difference to the basic rate of return on the bypass.

Taken as a whole the tests show that the project is most sensitive to changes in the value of time. Even the most pessimistic scenario of zero traffic and income growth and zero value of leisure time applied to 83 per cent of cars leaves the project with a 6.84 per cent rate of return. The test discount rate used by the Department of Finance for public investment projects is 5 per cent.

TABLE 9: Naas Bypass Rates of Return (%) for Various Traffic and Income Growth Rates

	Income Growth (%)					
Traffic Growth (%)	2	3	4	5	6	7
	Case (a) Leisure Time Valued at 25% of Work Time					
2	20.51	21.70	22.88	24.06	25.25	26.44
3	21.66	22.87	24.06	25.25	26.46	27.66
4	22.83	24.04	25.24	26.45	27.66	28.87
5	23.98	25.21	26.43	27.65	28.87	30.08
6	25.16	26.39	27.62	28.85	30.08	31.31
7	26.32	27.56	28.80	30.04	31.29	32.52
	Case (b) Zero value for Leisure					
2	15.06	16.19	17.32	18.46	19.59	20.72
3	16.16	17.30	18.45	19.59	20.73	21.87
4	17.27	18.42	19.57	20.72	21.87	23.03
5	18.37	19.53	20.70	21.87	23.03	24.19
6	19.47	20.64	21.83	23.00	24.18	26.35
7	20.59	21.77	22.95	24.14	25.32	26.51

In Table 9 we examine the effects of changing the assumptions for income and traffic growth on the rates of return for the basic model and the basic model with zero value of leisure time. These are Tests 1 and 3 of Table 8.

Implications for Road Investment Policy

The positive rate of return on the Naas bypass suggests that similar projects might be examined for other congested towns on the national primary route network such as Newbridge, Athlone, Ballinasloe, Roscrea, Nenagh, and Arklow, including studies of less expensive inner relief roads such as that at Portlaoise.

The results indicate that in order to cover the annualised cost of the motorway a toll of an average of 50p would have to be charged. Collection cost would absorb about 25 per cent of revenue according to the Road Research Laboratory estimates of the cost of converting the M1 to a tollway.

Table 3 shows that almost 5,000 vehicles using the N9 will benefit from the bypass through reduced traffic congestion in Naas. It will not be possible to recoup in toll revenue any of these benefits from the bypass or from traffic on the N7 which continued to go through Naas, or local Naas town traffic.

The average time saving for N7 traffic is low at 10.28 minutes from 8 am to 8 pm and 6.10 minutes for the rest of the day. Delays at the collection points would negative part of the savings. At off-peak times a toll might divert traffic to the centre of Naas when it is relatively uncongested. The toll might be more expensive to collect due to overtime working. Since over 70 per cent of traffic moves between 8 am and 8 pm there may be a case for having the bypass toll free after 8 pm in Winter and somewhat later at other times.

The value of leisure time used in the study is 72.5p per hour. A 10.28 minute saving is worth only 12p per person or 22p including car passengers. With a toll of 22p, business travellers will enjoy a substantial consumer surplus from the bypass. Setting the toll high enough to recoup some of this consumer surplus would divert the leisure traffic back to Naas centre.

Road transport, on average, covers its road infrastructure costs. Feeney (1983) estimates that all classes of vehicles now cover their infrastructure costs. A case could be made, therefore, for setting any proposed toll on the bypass to cover only the marginal costs of the motorway over a normal dual-carriageway route. This is about 40 per cent of motorway costs and might divert traffic back to Naas centre. Some time savings would be lost in collection.

The Environmental Impact of the Naas Bypass

The COBA evaluation of highway investments in terms of time savings, accident cost reduction, and fuel savings was found by the Leitch Committee to be "basically sound . . . provided it is kept within the overall framework suggested" (p.87). The Leitch Committee examined "the weights given to economic and environmental factors" and recommended that the COBA assessment be accompanied by a project impact matrix dealing with the amenity and environmental aspects of road investment. Table 10 shows the summary of this project impact matrix from Button (1982). In a "first best" evaluation of the bypass these items would be shadow priced and included in the quantified internal rate of return. We are presently unable to give this breadth to the cost benefit analysis of road investment. These unquantifiable items are none the less important.

TABLE 10: The Project Impact Matrix Suggested by the Leitch Committee

Incidence Group	Nature of Effect	Number of Measure	
		Financial	Other
Road Users	Accident savings	1	3
	Comfort and covenience		1
	Time savings	6	
	Vehicle cost savings	5	
	Amenity		2
Non-road users	Demolition of property/disamenity		22
	Demolition/disamenity to users of schools, churches, public open space		25
	Land-take, severence, and disamenity to farmers		7
Those concerned with intrinsic value of area	Landscape, scientific and historic value	3*	
Those indirectly affected	Sterilisation of natural resources, land use planning effects, effects on other transport operators		6*
Financial authority	Cost and financial benefits	7	
		22	66

*plus verbal description
Source: K. Button, adapted from the Leitch Report.

In the summaries of the environmental studies which follow, we see that Naas suffered from serious noise, lead, and smoke pollution. However, the level of sulphur dioxide was only a third of the central Dublin level. The bypass will reduce the noise, lead and smoke pollution by removing 12,000 vehicles a day from Naas and increasing the speeds of those remaining. The other environmental impacts listed in the Leitch Report are small in the case of the Naas bypass. The impacts concerned are demolition of buildings, visual intrusion of the highway in the area of buildings, farm severance, and the effect on natural assets.

Noise

Road traffic noise in Britain was found to be the most serious cause of noise nuisance by the Noise Advisory Council (1974). Noise nuisance is measured in weighted decibels or dB(A). The Wilson Committee (1963) recommended maximum daytime levels of 40 dB(A) in country districts, 45 dB(A) in suburban areas, and 50 dB(A) in urban areas and that these should not be exceeded for more than 10 per cent of the time.

Pryke and Dodgson (1975) estimate that in 1970, 21 million people in Britain lived in dwellings with an external noise level above 65 dB(A) for over 10 per cent of the time. Since closing windows reduces noise inside a dwelling by 16 dB(A) an acceptable level of noise inside the house is not possible where the external noise level exceeds 65 dB(A).

Noise levels in Naas exceeded the British target level of 65 dB(A) in two of the three locations examined by the Health Inspectorate of Dublin Corporation in 1978. The noise index values found were as follows—

Dublin Road	17 August 1978	79 dB(A)
Naas centre	30 August 1978	82.5 dB(A)
Newbridge Road	29 August 1978	64 dB(A)

The reduction in the number of vehicles using Naas from 19,000 to 9,000 per day will reduce the noise nuisance in the town centre. The new route has design features which minimise the impact of noise and confine it to a smaller number of people.

Atmospheric Pollution

Lead pollution in Naas is reduced in two ways by the new road. Twelve thousand vehicles a day will be taken out of the town while those remaining move faster thus reducing their lead pollution. Mean air-lead concentration in Naas in the summer of 1979 was high and comparable with that in central Dublin.

Smoke pollution in Naas was also close to central Dublin levels. It is mostly due to traffic. Sulphur dioxide, on the other hand, was only a third of the central Dublin levels.

The transfer of vehicle pollution away from Naas disperses it over a wider area with a smaller population. Table 11 shows the pollution in Naas before the bypass.

TABLE 11: Pollution in Naas and Dublin, Summer 1979

	May	June	July	Mean
	(a) Air Lead Concentration in Micrograms per Cubic Metre			
Naas Centre	2.65	2.06	1.42	2.04
O'Connell Street	2.30	2.30	2.30	2.30
Dame Street	4.5	2.7	2.3	3.5
	(b) Sulphur and Smoke in Micrograms per Cubic Metre			
		Sulphur	Smoke	
Naas Centre		19.8	36.3	
Dame Street		61.8	32.5	
Clontarf		20.5	9.3	

Source: Kildare County Council and Dublin Corporation.

The Impact on the Physical Environment

The Leitch Report proposed the inclusion of the following effects in the assessment of highway investments:- (a) the number of buildings to be demolished, (b) the number of buildings exposed to visual intrusion, (c) the land of each grade required by the scheme, (d) the impact on farm severence and (e) the impact on natural assets.

Only one cottage was demolished in the construction of the Naas bypass. The main areas of housing close to the bypass are at Monread and Osberstown. Here the motorway is in a cutting and trees will be planted to reduce noise and visual intrusion. The land used in the bypass was of high grade. However, the use of material from two gravel pits in the vicinity of the bypass has exhausted the pits and the area can now be restored to agricultural use.

Two new bridges reduce the impact of farm severence and a new accommodation road has been built. Four farms severed have access through existing public roads. One has an accommodation bridge and six are served by a new bridge and accommodation road. Three small parcels of land (1.4, 1.5 and 5 acres) which were isolated from their main farms have been acquired by Kildare Council.

The bypass leaves adequate headroom over the Naas branch of the Grand Canal. This preserves the option that the branch might be restored as an amenity in the future.

The environmental costs of a motorway in a previously rural area are a relatively new area of research. The design of the Naas bypass incorporates several attempts to reduce these costs. They should, however, be kept under review but are probably much less than the environmental costs caused by the same traffic in the centre of Naas.

Improving Road Investment Evaluation

Time, accident costs savings, and fuel savings are the quantified benefits from road investment. Time savings dominate the benefits from the Naas bypass and should be carefully evaluated in the assessment of road investments.

Project surveys should ascertain the wage costs of those likely to benefit from the investment, the division of users between work and non-work trips, and the spread of traffic over 24 hours. Actual incomes of beneficiaries should be used rather than those imputed from COBA. A time savings study might also examine whether the 25 per cent value for leisure time savings is correct in Ireland.

Current British research seeks to establish accident costs from the compensation which people trade off against risks. It is likely that the COBA estimates of accident costs will be raised thus increasing the rate of return from road investment.

A standard form of assessment, or Irish COBA, even if imperfect, would ensure comparability of highway investment appraisal between different projects. This would include both the quantified benefits and the environmental impact assessments recommended in the Leitch Report.

The development of wider cost benefit analysis could permit comparison of transport and other investments including those in the private sector with market prices "corrected" for social spillovers and market imperfections. Finally, in the difficult circumstances of the Irish public finances it is important that the appraisal should not exclude low cost solutions such as inner relief roads.

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APPENDIX

Fuel Consumption on N7 through Naas (gallons)

	Section 1	2	3	Total per vehicle	Number of vehicles	Total fuel consumption
08.00 to 20.00						
Cars	0.056	0.103	0.031	0.19	9983	1897
Light goods	0.080	0.122	0.390	0.241	1139	274
Diesel	0.180	0.223	0.089	0.492	2369	1166
20.00 to 08.00						
Cars	0.056	0.067	0.031	0.154	4077	628
Light Goods	0.080	0.081	0.039	0.20	465	93
Diesel	0.180	0.175	0.089	0.444	968	430

These estimates are based on COBA.