

indicated as the main causative factor (McGrath, 1995). This is similar to the pattern found in the UK and US, for larger towns. It is now recognised that soil composition has a major effect on heavy metal assimilation by humans through soil ingestion and dust inhalation (McGrath, D. pers. comm.).

Overall it was found that copper was the trace element most indicative of human induced contamination in the investigation. The trace element content of soils from the industrial area examined (Cork Harbour) was not considered to be exceptional (McGrath, 1995).

Table 11.2 Irish Soils: Trace Element* Content (ug/g) (McGrath, 1995).

		Agricul- tural	Urban Amenity	Town Garden	Sub- urban Garden	Industrial area
Cd	max	95.8	0.64	1.73	0.44	-
	min	0.06	0.24	0.18	0.05	-
	mean	6.6	0.44	0.70	0.22	-
Cu	max	180.2	45.0	122.9	31.6	34.1
	min	8.1	32.7	18.0	21.1	21.9
	mean	29.6	38.4	61.5	26.5	27.4
Cr	max	69.2	49.3	96.2	50.0	67.1
	min	21.2	32.4	35.7	43.2	42.9
	mean	49.0	40.2	61.2	44.8	52.9
Hg	max	0.32	0.66	2.97	0.14	-
	min	0.03	0.26	0.09	0.08	-
	mean	0.09	0.42	0.68	0.11	-
Ni	max	120.6	19.2	40.7	17.7	34.6
	min	10.4	14.2	14.8	11.0	13.3
	mean	30.7	16.7	26.7	15.1	22.3
Pb	max	42.8	827	1609	39	68
	min	10.3	109	16	28	28
	mean	25.8	355	302	33	48.6
Zn	max	126	226	404	89	270
	min	28	104	68	43	91
	mean	78.3	158	200	66	139

* Cadmium (Cd); Copper (Cu); Chromium (Cr); Mercury (Hg); Nickel (Ni); Lead (Pb); Zinc (Zn).

Organic Micropollutants

The survey described above also involved the measurement of organic micropollutants in soils (McGrath, 1995) and a summary of the findings is given in Table 11.3.

Of the major categories of chlorinated trace organics which are now universally distributed, hexachlorocyclohexane (HCH) (including lindane) and polychlorinated biphenyls (PCBs) (from electrical equipment mainly but formerly widely used in products such as paints and fire retardants) were present in soil at levels indicative of little or no history of contamination. However, dichlorodiphenyltrichloroethane (DDT) and its breakdown products are still present at a sizeable level in some agricultural soils (mainly fruit growing enterprises) but especially in town garden soils where they were found in most soils. This is probably a legacy of widespread domestic use of DDT in the past. It was concluded that the largest value (1845.5 ng/g) in a town garden, may be unusual; it came from a former orchard. In Ireland, DDT was banned several years ago for use in plant protection products.

The organochlorine levels associated with the industrial site were not unlike those from the agricultural sites. The PCBs content, however, was the highest recorded in the investigation, although it was low in comparison with some levels recorded in other countries (McGrath, 1995).

Table 11.3 Irish Soils: Organic Micropollutant Content (ng/g) (McGrath, 1995).

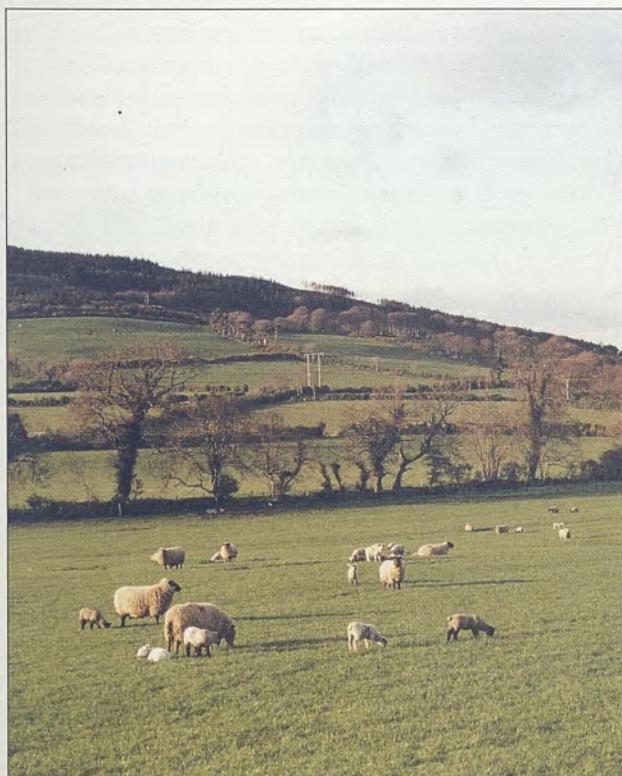
		Agri- cultural	Urban Amenity	Town Garden	Sub- urban Garden	Industrial area
Total						
HCH	max	3.99	2.03	12.40	8.87	1.65
	min	0.24	0.56	0.00	0.58	0.20
	mean	1.16	1.14	3.28	5.62	0.75
Total						
DDT	max	89.7	3.25	1845.5	11.1	2.71
	min	0.02	0.50	4.6	0.6	0.09
	mean	12.32	1.84	311.1	4.37	0.88
Total						
PCBs	max	6.63	3.12	-	-	9.39
	min	1.25	2.69	-	-	0.24
	mean	3.49	2.97	-	-	1.97

Nutrient Levels in Soils

Approximately two million tonnes of phosphorus (P), in chemical fertiliser, have been applied to soils in Ireland over the past 40 years. The average extractable soil P level of the soils tested has increased from 0.5 to 8.2 mg/l in that period while soil potassium (K) has increased from 22 to 111 mg/l.

The P status of some of the soils tested is high enough to permit optimum crop production for a number of years without added P fertiliser. This is particularly true on soils receiving high rates of slurry, especially pig and poultry slurry. Research carried out by Teagasc indicates that up to 30 per cent of farmland may be using excessive amounts of nitrogen (N), P and K. On the other hand 25 per cent of soil samples are still deficient in P (Tunney, 1990). The total P input to Irish agriculture is more than double the output (Tunney, 1990). This means that the soil P reserves are continuing to increase. A survey of P levels has recently begun in which soils are selected on a grid basis and this can form a reliable basis for determining future trends.

Losses to water are recognised as an important factor contributing to eutrophication. In 1953, the national P loss from agriculture to water was estimated at 500 tonnes per annum (Lee, 1995). The present loss is roughly estimated at 2,100 tonnes per annum - a four fold increase (Tunney, 1990).



There is evidence that the efficiency of the utilisation of N in fertiliser is decreasing as the quantity used increases. Total output represents only 16 per cent of total inputs. A further 12 per cent may be immobilised in the soil. This means that 72 per cent of N inputs are not recovered in soil or in animal products and must be lost to water and the atmosphere thus showing that the efficiency of the utilization of nitrogen is decreasing as application rates are increasing. Mean losses of N by leaching in the grassland soils are low. There are exceptions to this, i.e., shallow light textured soils and soils where excessive N is applied via fertiliser, slurry and dirty water. In the arable sector, N is more likely to leach from fallow than from cropped land. The amounts leached depend on rates of breakdown of organic N, N fertiliser use, crop growth, soil type and weather. Year to year variations can be quite large.

RADIOACTIVITY

Levels in Livestock

A programme of monitoring of radioactivity levels by the Radiological Protection Institute of Ireland (RPII) in sheep and sheepmeat is being continued. Some sheep grazing on upland pastures still register levels of radiocaesium as high as 1,000 Bq/kg. This is due to the persisting bioavailability of radiocaesium deposited on poor quality upland soils in some parts of the country following the Chernobyl accident. Before being slaughtered, sheep from these areas need to be grazed on lowland pastures where activity levels in their flesh decrease rapidly. Live sheep are monitored in the high risk areas and there are checks at local slaughterhouses and retail outlets. The results show that the measures being taken are effective in ensuring that consumption of sheepmeat does not constitute a significant health hazard.

Radon

Radon is a naturally occurring radioactive gas which is formed in the ground. It is colourless and odourless and so can only be detected with special equipment. Radon which surfaces in the open air is quickly diluted to harmless concentrations in the atmosphere, but when it enters an enclosed space it can sometimes build up to an unacceptably high concentration. The risk of contracting lung cancer from radon can be significant, depending on the radon level, exposure time, and whether or not one smokes (Source: RPII).

The average radon concentration in Irish houses is about 60 Bq/m³ compared with typical outdoor values of about 5 Bq/m³. It is believed that about four per cent of houses in Ireland have concentrations above the Reference Level of 200 Bq/m³, and indoor radon concentrations of up to 4000

Bq/m³ have been measured. While houses with high radon levels are found throughout the country, there is evidence of a greater incidence of such houses in the west of Ireland. Surveys of radon in dwellings have been conducted by the RPII in selected areas of the country, particularly in counties Mayo, Galway and Clare and parts of Cork and Kerry. The surveys showed that there is considerable variation in the scale of the radon problem. The predicted percentages of houses with radon levels in excess of the reference level of 200 Bq/m³ were highest in parts of Galway and Mayo (Source: RPII).

The issue of radon is also addressed in the building control system which came into operation in 1992. Under the system, precautions must be taken in the design and construction of new buildings to avoid danger to health and safety caused by substances (including contaminants) on or in the ground to be covered by the building. The relevant Technical Guidance Document, which gives advice in relation to meeting this requirement, points to the need to take precautions against the entry of radon into buildings in certain areas. In this regard, guidance on appropriate measures to be taken in the design and construction of buildings has been published separately by the Department of the Environment (DoE). This guidance also covers remedial measures which may be taken in existing buildings.

LITTER

Litter and unauthorised dumping together form one of the more persistent and visible environmental problems of the terrestrial environment. As noted in Chapter 2, attitudes surveys have shown that litter, particularly on beaches and at other public places, was identified as the leading environmental concern of most people.

Legislative controls in relation to litter are contained in the Litter Act, 1982. Aspects of litter have been assessed in Chapter 7.

Anti-litter Initiative

A new anti-litter initiative is currently being undertaken by the DoE to counter the persistent and visible problems. It will be targeted at and operated in partnership with local authorities and other public sector bodies, business and industry, schools, voluntary and community groups, environmental non-governmental organisations (NGOs), farming and tourism interests. The key objectives of the initiative will be as follows: to focus and maintain public attention on litter as an urgent environmental problem; to step up the enforcement of existing legislation; to develop improved systems, including revised legislation, for the

control of litter; and to develop a continuous series of anti-litter measures over the next two years at least.

Plastics

As noted in Chapter 7, plastics can be particularly intrusive visually, e.g., those which get blown onto hedges and trees or mark flood water levels on river banks. Large plastic sheeting is now widely used in the countryside. A recent study (EMA, 1993), showed that agriculture (35 per cent) and horticulture (3 per cent) together account for a significant proportion of polyethylene film waste generated in Ireland. The main use category is commercial/distribution at 55 per cent; peat extraction accounts for 1.5 per cent. The study found that the bulk of polyethylene film waste which is generated in the agricultural and horticultural sectors is burned on the farm, and an element of this waste ends up discarded around the countryside.

INFORMATION GAPS

In relation to forestry, further research is needed on the interaction of trees and aquatic systems in order to update current guidelines. A sustained programme of broadleaf research is needed, to include inventories, improved quality and diversity, treatment options and general environmental considerations relating to forestry.

Further information is needed on the extent of soil degradation and erosion caused mainly by overgrazing on hill and mountain areas. In particular, it is necessary to quantify the extent of the problem, the rate at which the changes have been occurring and current trends. The effects of the REPS scheme will need to be reviewed in order to assess its effectiveness in combatting the problem. There is a shortage also of information on contaminated sites, although it seems clear that the numbers and extent of these would not be significant in comparison with many other countries.

A more up-to-date review of landscape quality is desirable, including a review of the factors now operating to bring about changes to the landscape in Ireland, and an assessment of options for ensuring better protection of important landscapes.



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NATURAL HERITAGE

INTRODUCTION

The natural heritage of a country is by definition its inheritance of the natural environment and is a legacy of geological history and climate as well as man's influence. The deforesting of Ireland in past centuries has affected the natural environment and consequently the flora and fauna while other influences, such as grazing by livestock, have also shaped the countryside.

The natural environment with its flora and fauna is particularly important to a country like Ireland where these features are among the main reasons for the flourishing tourist industry. Thus, quite apart from the moral standpoint or any intrinsic value, it makes good economic sense to protect and conserve the natural heritage. Nature conservation has been defined as "the sustainable use of nature" and is chiefly concerned with conserving, maintaining and protecting the natural environment.

The formulation of Government policy in relation to nature conservation is the responsibility of the Minister for Arts, Culture and the Gaeltacht and this policy is implemented by the National Parks and Wildlife Service (NPWS). The policy aims at reflecting national and international awareness of the critical need to conserve natural resources and to maintain biodiversity. The Minister, under the terms of the 1995 Heritage Act, has appointed a 15-member National Heritage Council whose functions include proposing policies and priorities to conserve Ireland's natural and built heritage.

The NPWS administers and enforces the Wildlife Act of 1976, the Whale Fisheries Act of 1937 and the European Union Directives where they relate to wildlife conservation, through the following measures:

- regulating the taking, hunting and trading of protected species;
- conserving natural habitats, native plant and animal species and communities for the maintenance of biodiversity;
- promoting knowledge and understanding of the natural world through research and education;
- co-operating and liaising with national and international organisations whose objectives are relevant to wildlife conservation.



Conservation of Native Woodland

The post-glacial landscape of Ireland was essentially a woodland one, in which lakes, fens, bogs and other habitats were no more than relatively small islands in a sea of woodland. Today, woodland is reduced to small islands in a sea of farmland. Clearly human populations and their animals were the single most important factor in bringing about this change.

Ireland now has proportionally the smallest area of native woodland still intact in Europe. The NPWS is aware of this and is taking steps to conserve as much as possible of what is left. Substantial areas of woodland are already conserved in some of the National Parks and Nature Reserves. The broader issue of conservation in private native woodlands is also being looked at. The proposed Natural Heritage Areas and the Special Areas of Conservation programmes will help in the identification of relevant areas. Ways of helping owners to keep their native woods under broadleaf species also need consideration.

(Source: NPWS)

HABITAT AND SPECIES PROTECTION

Ireland has been described as the last outpost of Eurasia and because of its westerly position it is important to the biogeographer as a boundary or limit for the range in distribution of European plants and animals. For its size, Ireland has a higher diversity of habitats due to its varied geology, than some European countries of comparable size. The variety of species, however, is low by comparison with that of its neighbouring island. Among the many British animals which are missing in the Irish fauna may be mentioned the weasel (*Mustela nivalis*) and mole (*Talpa europaea*). However, despite the lack of diversity in species, there are interesting elements to the flora and fauna including species which do not occur in Britain.

National Provisions

The Wildlife Act, 1976, is the principal national legislation regarding the protection of habitats and species. Its aims are to provide for the protection and conservation of wild flora and fauna, to conserve a representative sample of important ecosystems and to provide the services necessary to accomplish such aims. The Whale Fisheries Act, 1937, in conjunction with the Wildlife Act, 1976, provides the legal framework under which the hunting of all whale species, including dolphins and porpoises, has been totally banned within the exclusive fishery limits of the State, i.e., out to

200 miles from the coast. This Whale and Dolphin Sanctuary, created in 1991, was the first European sanctuary within the exclusive fishery limits of an entire country. The Foreshore (Amendment) Act, 1992, provides the Minister for the Marine with the power to ban sand or stone removal from any beach or classes of beach and to prohibit any activities which are deemed to disturb the sea-shore. Specific areas of conservation importance may be designated for protection under the Wildlife Act. The network of reserves includes woodlands, peatlands, grasslands, sand dune systems, fens, coastal heathlands, marine areas and bird sites. Some relevant provisions under the Wildlife Act, 1976, are summarized below.

Nature Reserves

Where areas meet certain scientific criteria and comprise wildlife habitats worthy of conservation, they may be established and managed as nature reserves. These sites may be in State ownership or may be privately owned. In relation to privately owned land, a provision under the Wildlife Act allows nature reserves to be established by management agreement with the landowners. Nature reserves can include land, land covered by inland waters, foreshore and land forming the seabed within a three mile limit from the coast. To date, 76 Nature Reserves have been established (see Fig. 12.1).

Refuges for Fauna

Selected areas may be designated as refuges for particular species of wild birds or other wild animals and protective measures may be imposed which are designed to conserve both the species and their natural habitats. The seven Statutory Refuges for Fauna so far designated are: Lady's Island Lake, Co. Wexford; Cliffs of Moher, Co. Clare; Horn Head, Co. Donegal; Rockabill Island, Co. Dublin; Old Head of Kinsale, Co. Cork; the Cow Rock and Bull Rock, Co. Cork.

Wildfowl Sanctuaries

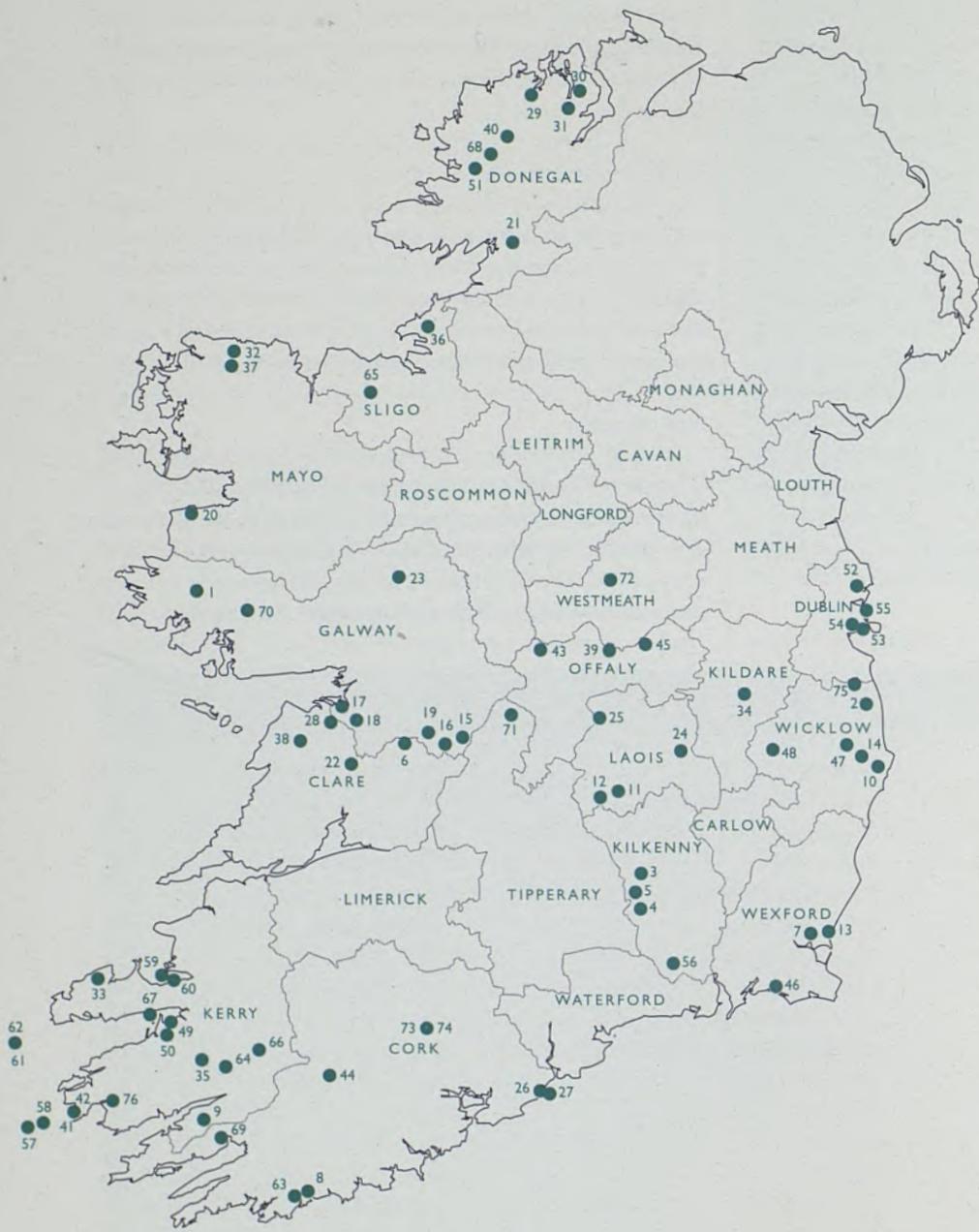
All wild birds are protected under the Wildlife Act. Areas of importance for bird life may be designated as wildfowl sanctuaries by prohibiting the shooting of traditional game bird species in the area. The 68 wildfowl sanctuaries designated under the Act are delineated in Fig 12.2.

Flora Species

Under the Wildlife Act (Flora Protection Order of 1987), 68 species of flowering plants and ferns (see Table 12.1) and their habitats are protected. Under the Act it is an offence to cut, pick, uproot, purchase, sell or damage any of the protected species without a licence from the NPWS.

Table 12.1 Plant Species Protected Under the Wildlife Act (Flora Protection Order of 1987).

Autumn Crocus [Meadow Saffron]	Birdsfoot	Northern Rockcress
Basil-Thyme	Round Prickly-headed Poppy	Starved Wood Sedge
Parsley Fern	Cottonweed	Lesser Centaury
Chives	Irish Hydrilla	Round-leaved Wintergreen
Bog Hair Grass	Slender Cotton Grass	Great Burnet
Chickweed Willow Herb	Irish Sandwort	Three-lobed Water Crowfoot
Dorset Heath Grass	Perennial Glasswort	Meadow Saxifrage
Limestone Fern	Wild Asparagus	Hart's Saxifrage
Bog Orchid	Narrow-leaved nettle	Yellow Marsh Saxifrage
Common Rockrose	Opposite-leaved Pondweed	Alpine Saxifrage
Meadow Barley	Lanceolate Spleenwort	Triangular Club Rush
Canadian St. John's Wort	Forked Spleenwort	Kerry Lily
Hairy St. John's Wort	Fluellen	Drooping Lady's Tresses
Hairy Birdsfoot Trefoil	Sea Pea	Killarney Fern
Penny Royal	Slender Cudweed	Woundwort
Lesser Snapdragon	Pillwort	Cluster Clover
Slender Naiad	Purple Milk Vetch	Globe Flower
Oyster Plant	Sea Knotgrass	Subterranean Clover
Water Dropwort	Bushgrass	Hairy Violet
(<i>Oenanthe pimpinelloides</i> L.)	Alpine Bistort	Bitter Vetch
Wood Cudweed	Bats-in-the Belfry	Pale Heath Violet
Recurved Sandwort	Small white Orchid	
Green-winged orchid	Narrow-leaved Bitter Cross	
Willow-leaved Inula	Tufted Salt-marsh Grass	



Nature Reserves

- 1 Derryclare
- 2 Glen of the Downs
- 3 Ballykeefe
- 4 Garryricken
- 5 Kyleadohir
- 6 Caher (Murphy)
- 7 Wexford Wildfowl Reserve
- 8 Lough Hyne
- 9 Uragh Wood
- 10 Deputy's Pass
- 11 Grantstown Wood
- 12 Coolacurragh Wood
- 13 The Raven
- 14 Vale of Clara
- 15 Rosturra Wood
- 16 Derrycrag Wood
- 17 Ballynastaig Wood
- 18 Coole-Garryland
- 19 Pollnacknockaun Wood
- 20 Oldhead Wood
- 21 Pettigo Plateau
- 22 Dromore
- 23 Richmond Esker
- 24 Timahoe Esker
- 25 Slieve Bloom Mountains
- 26 Capel Island & Knockadoon Head (State Owned)
- 27 Capel Island & Knockadoon Head (Privately Owned)
- 28 Keelhillia, Slieve Carron
- 29 Duntally Wood
- 30 Rathmullan Wood
- 31 Ballyarr Wood
- 32 Knockmoyle Sheskin
- 33 Mount Brandon
- 34 Pollardstown Fen
- 35 Eirk Bog
- 36 Ballygilgan
- 37 Owenboy
- 38 Ballyteige
- 39 Clara Bog
- 40 Lough Barra Bog
- 41 Puffin Island (State owned)
- 42 Puffin Island (Privately owned)
- 43 Mongan Bog
- 44 The Gearagh
- 45 Raheenmore Bog
- 46 Ballyteige Burrow
- 47 Glendalough
- 48 Glenealo Valley
- 49 Lough Yganavan
- 50 Lough Nambrackdarrig
- 51 Derkmore Wood
- 52 Rogerstown Estuary
- 53 North Bull Island (State owned)
- 54 North Bull Island (Privately owned)
- 55 Baldoyle Estuary
- 56 Fiddown Island
- 57 Great Skellig
- 58 Little Skellig
- 59 Tralee Bay
- 60 Derrymore Island
- 61 Teraght Island (State owned)
- 62 Teraght Island (Privately owned)
- 63 Knockomagh Wood
- 64 Derrycunihy Wood
- 65 Easley Bog
- 66 Sheheree Bog
- 67 Castlemaine Harbour
- 68 Meenachullion
- 69 Glengariff Wood
- 70 Leam West Bog
- 71 Redwood Bog
- 72 Scragh Bog
- 73 Kilcolman Bog (State owned)
- 74 Kilcolman Bog (Privately owned)
- 75 Knocksink Wood
- 76 Cummeragh River Bog

Fig. 12.1 Nature Reserves Designated Under the Wildlife Act, 1976 (from data supplied by NPWS).

Wildfowl Sanctuaries

- 1 River Barrow (Muine Bheag)
- 2 Lough Oughter Group
- 3 Lough Ramor
- 4 Dartrey/Fairfield
- 5 Ballyallia Lake
- 6 Islandavanna
- 7 Mutton Island
- 8 Ballynamona-Shanagarry
- 9 Kilcolman Bog
- 10 Lough Aderry
- 11 The Lee Reservoir
- 12 The Lough
- 13 Ards
- 14 Blanket Nook
- 15 Dunfanaghy Lake
- 16 Lough Fern
- 17 Trawbreaga Bay
- 18 Brittas Ponds
- 19 The North Bull Island
- 20 Rogerstown Estuary
- 21 Coole Lough
- 22 Lough Derg (parts)
- 23 Muchanagh/Cloonlaughnan
- 24 Coon, Ventry
- 25 Derrycunihy/Gallavally
- 26 Doolough/Tullaha
- 27 Inch/Castlemaine Harbour (part)
- 28 Lough Gill
- 29 Rossbehy/Caragh Creek
- 30 Ballynafagh Lake (Blackwood Lake)
- 31 River Barrow (Goresbridge)
- 32 Lough Cullin (Holy Lake)
- 33 Lough Gur
- 34 City of Limerick (part)
- 35 Ballymascanlan Estuary
- 36 Lurgan Green
- 37 Carrowmore Lake
- 38 Inishkea Islands
- 39 Lough Carra
- 40 Lough Conn
- 41 Boyne Estuary (part)
- 42 Emy Lough
- 43 Little Brosna
- 44 Annaghmore Lough
- 45 Lough Croan
- 46 Lough Funshinagh
- 47 Lough Key (part)
- 48 Lough Gara
- 49 Drumcliffe Bay (part)
- 50 Coolfin Marshes
- 51 River Blackwater
- 52 Coosan Lough/Killinure Lough
- 53 Lough Iron
- 54 River Slaney (part)
- 55 Rosslare Point
- 56 Tacumshin Lake (part)
- 57 Tern Island
- 58 Broad Lough
- 59 Poulaphouca
- 60 Tullaheer Lough
- 61 Sheskinmore Lough
- 62 Lough Rusheen
- 63 Moyne
- 64 Marlfield Lake
- 65 Bannow Bay
- 66 Lough Mask
- 67 Douglas Estuary
- 68 Inagh River (part)

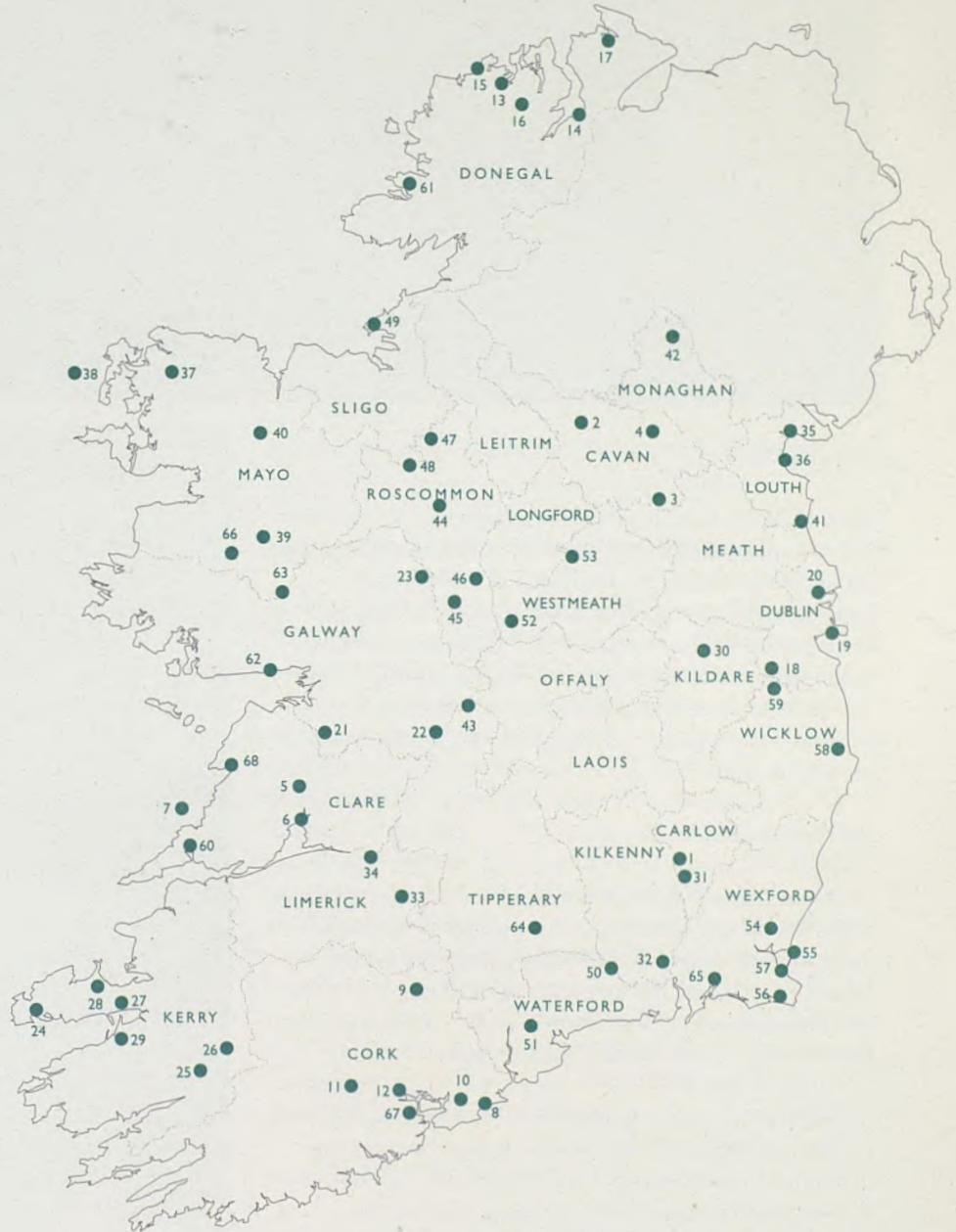


Fig. 12.2 Wildfowl Sanctuaries Designated Under the Wildlife Act, 1976 (from data supplied by NPWS).

Table 12.2 Fauna Species Protected Under the Wildlife Act, 1976 (Source: NPWS).

Mammals	Birds	Reptiles	Amphibians	Invertebrates
Badger	All wild birds*	Common lizard	Common frog	Kerry slug
Red squirrel		Marine turtles	Common newt	Crayfish
Bats			Natterjack toad	Pearl mussel
Stoat				
Deer				
Hares				
Hedgehog				
Otter				
Pine marten				
Pygmy shrew				
Dolphins				
Porpoises				
Seals				
Whales				

*The control of certain opportunistic species is allowed under derogations (hooded crow, magpie, rook, jackdaw and pigeons), where these species are causing damage to crops, livestock and fauna or where they represent a threat to public health. Airport authorities may also control certain species that represent a threat to air safety.

Fauna Species

The Wildlife Act also provides for comprehensive measures for the conservation and protection of wild fauna (including game species) and for the regulation of trade in and exploitation of species. Where species are classified as protected under the Act (see Table 12.2), it is unlawful to hunt, capture or kill such species except in accordance with licences or permissions issued by the NPWS. The unlicensed importation and export of wild species is also prohibited under the Act.

National Parks

Parks have been established which conform to the criteria of the World Conservation Union (IUCN). A National Parks and Heritage Areas Bill is being prepared by the Department of Arts, Culture and the Gaeltacht to provide statutory protection for national parks and other important natural areas. The five National Parks are:

- Wicklow Mountains National Park, Co. Wicklow, 12,211 ha.
- Killarney National Park, Co. Kerry, (incorporating the Bourn Vincent Memorial Park), 10,129 ha.
- Glenveagh National Park, Co. Donegal, 12,343 ha.
- Connemara National Park, Co. Galway, 2,699 ha.
- Burren National Park, Co. Clare, 1,562 ha.

A feasibility study has been undertaken on the establishment of a sixth National Park, in Co. Mayo. A detailed management plan for Killarney National Park was published in 1990 and management plans are in preparation for the other National Parks.

Glenveagh National Park



Glenveagh National Park lies along the Derryveagh mountains in the north-west of County Donegal; it was formerly a large private estate. Like Killarney, it has beautiful lakes set in impressive mountain scenery, but the underlying granite gives the landscape a quite different character from the sandstone and limestone of Killarney. Ecological similarities include natural woodlands, mainly of oak and birch, large tracts of bog and moorland and red deer, differing from those in Killarney in that they are not of native Irish stock. Much of the park shows little direct signs of human activity. This wilderness character, with the sense of remoteness and solitude that it conveys to the visitor, is perhaps the most outstanding feature of Glenveagh.



Wicklow Mountains National Park

The Wicklow Mountains National Park was established in January 1991. The initial core area is centred on the Glendalough valley and comprises the two nature reserves there (Glendalough Wood and Glenealo Valley) together with adjoining lands formerly held by the Forest Service. The internationally important Liffey Head Bog and adjoining lands north-east of the Sally Gap, have recently been acquired from the Powerscourt Estate and will be incorporated into the park in due course. Large areas of the Wicklow mountains are covered by a thin layer of peat with underlying gravelly soils. Two main vegetation types dominate the mountains: on drier sites a moorland type of vegetation occurs, with heathers (mainly ling) and bilberry as the predominant species; wetter sites are characterised by blanket bog vegetation, with sedges and bog mosses predominating. The national park also contains some important areas of oak woodland, most of which were originally plantations. Most of Ireland's native mammal species occur within the park, with a large population of deer occupying the open hill areas. A national park information office has been opened near the Lower Lakes at Glendalough.

(Source: NPWS)

Special Areas of Conservation (SACs)

SACs are natural habitats and habitats of species of European importance which will be designated under the

habitats Directive (see below). These sites will receive protection under proposed national legislation.

Proposed Natural Heritage Areas (NHAs)

A nation-wide survey of sites previously identified as Areas of Scientific Interest (An Foras Forbartha, 1981) was carried out between 1992 and 1994 to select sites for designation as Natural Heritage Areas (NHAs). These are sites or habitats of special interest for their fauna or flora; 1,250 sites are being designated (see Fig. 12.3). Proposed amendments to the Wildlife Act, 1976, will give NHAs a statutory basis. Most of these sites are in private ownership and landowners have the right to appeal against designations on scientific grounds. The Department of Agriculture, Food and Forestry has included the proposed NHAs in the Rural Environment Protection Scheme (REPS) and increased grant-aid is available to applicants whose lands fall within these areas. Following discussions between the Geological Survey of Ireland (GSI) and the Office of Public Works (OPW), geological sites have been included in the draft of the Wildlife Amendment Bill, 1994.

International Provisions

Wild Birds Directive

The wild birds Directive (CEC, 1979) establishes a system of general protection for all wild birds and their habitats throughout the EU. It is implemented in Ireland through the Wildlife Act. Under Article 4 of the Directive, Member States are obliged to designate their most important sites as Special Protection Areas (SPAs) for the conservation of species which are:



Fig. 12.3 Proposed Natural Heritage Areas (NPWS, reproduced by kind permission of the Minister for Arts, Culture and the Gaeltacht).

Wetland Sites

- 1 Wexford Wildfowl Reserve
- 2 The Raven Nature Reserve
- 3 Pettigo Plateau Nature Reserve
- 4 Slieve Bloom Mountain Nature Reserve
- 5 Owenduff Catchment
- 6 Lough Barra Bog Nature Reserve
- 7 Owenboy Nature Reserve
- 8 Knockmoyle/Sheskin Nature Reserve
- 9 North Bull Island & adjoining foreshore Nature Reserve
- 10 Rogerstown Estuary Nature Reserve
- 11 Baldoyle Estuary Nature Reserve
- 12 Clara Bog Nature Reserve
- 13 Mongan Bog Nature Reserve
- 14 Raheenmore Bog Nature Reserve
- 15 Tralee Bay Nature Reserve
- 16 Easkey Bog Nature Reserve
- 17 Castlemaine Harbour Nature Reserve
- 18 Coole/Garryland Nature Reserve
- 19 Pollardstown Fen Nature Reserve
- 20 Meenachullion Bog Nature Reserve
- 21 The Gearagh Nature Reserve

Special Protection Areas

- 1 Wexford Nature Reserve
- 2 Saltee Islands
- 3 Puffin Island
- 4 Iniskea Island
- 5 Cliffs of Moher
- 6 North Bull Island
- 7 The Skelligs
- 8 The Blaskets
- 9 Ladys Island Lake
- 10 Inish & Sgarbheen Islands
- 11 Lough Gill
- 12 Horn Head
- 13 Drumcliff Bay
- 14 Rockabill Island
- 15 Rogerstown Estuary
- 16 Baldoyle Estuary
- 17 Mongan Bog
- 18 Tralee Bay
- 19 The Raven
- 20 Ballyteigue Burrow
- 21 Old Head of Kinsale
- 22 Ballycotton Bay
- 23 Ballymacoda Bay
- 24 Sandymount Strand/Tolka Estuary
- 25 Broadmeadow/Swords Estuary
- 26 Dundalk Bay
- 27 Tramore Backstrand
- 28 Blackwater Estuary
- 29 Castlemaine Harbour
- 30 Cork Harbour
- 31 Galway Bay Inner
- 32 Dungarvan Harbour
- 33 Bannow Bay
- 34 Trawbreaga Bay
- 35 Cumeen Strand
- 36 Killala Bay
- 37 Blacksod/Broadhaven
- 38 Killarney National Park
- 39 Glenveagh National Park
- 40 Wicklow National Park

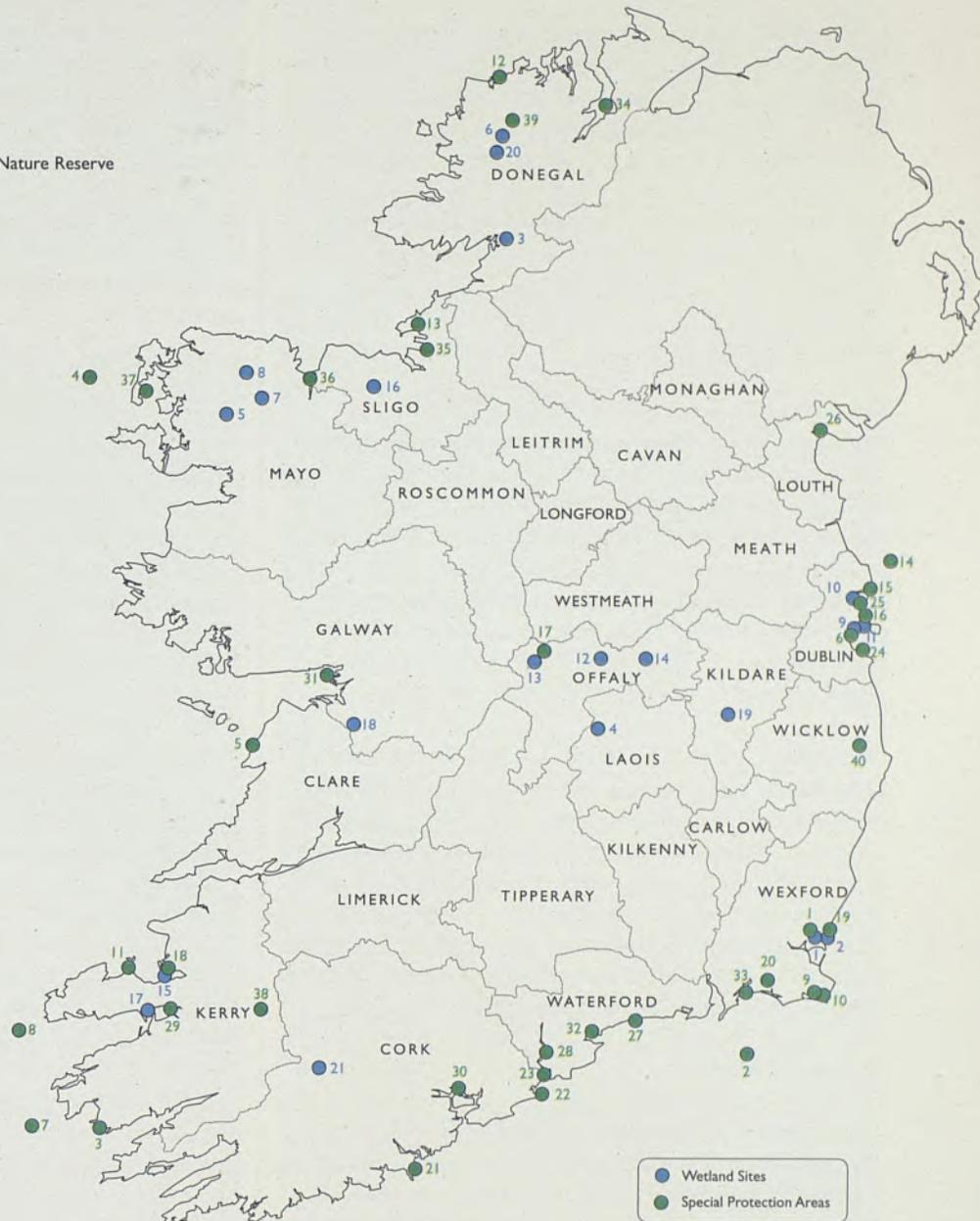


Fig. 12.4 Wetland Sites and Special Protection Areas (SPAs) Respectively Designated Under the Ramsar Convention and the EU Wild Birds Directive (from data supplied by NPWS; does not include SPAs designated in December 1995).

- in danger of extinction;
- vulnerable to specific changes in habitat;
- considered rare because of small populations or restricted distribution or need particular attention because of the specific nature of their habitat.

In Ireland, 40 sites (see Fig. 12.4) had been designated by October 1995 (JNCC, 1995). It may be noted that a further 35 sites, designated in December 1995, are not included in Fig. 12.4. The national regulations which cover these sites make pollution or damage to habitats arising from dumping on, or discharge into, them an offence. They do not, however, prevent deterioration of habitat by other means such as drainage, reclamation or change in land use practices.

Habitats Directive

The habitats Directive (CEC, 1992) is a legislative instrument on the conservation of natural and semi-natural habitats and of wild fauna and flora. It establishes a common framework for the conservation of animals, plants and natural and semi-natural habitats and provides for the creation of a network of SACs called "Natura 2000" (which also include SPAs) to maintain or restore, at favourable conservation status, natural habitats and species of wild fauna and flora of Community interest as listed in the Council Directive 92/43/EEC (see Appendix 12.1).

Under the terms of the habitats Directive there was an obligation on Ireland to submit a list of candidate SACs to the European Commission by June, 1995. SACs will be chosen from the national network of NHAs. Measures will have to be taken to avoid deterioration of SACs and, where development is proposed, account must be taken of the impact on the conservation status of the area. SPAs (Special Protection Areas) designated under the wild birds Directive will form an integral part of Natura 2000.

Biogenetic Reserves

The Council of Europe has established a network of Biogenetic Reserves which are protected areas with certain characteristic criteria. The purpose of these reserves is to guarantee the biological balance and hence the conservation of the sites, and to make the ecosystems available for biological research. The following 14 Nature Reserves have been designated as Biogenetic Reserves: Lough Hyne; Pettigo Plateau; Uragh Wood; Coole-Garryland; Slieve Bloom; Pollardstown Fen; Slieve Carron; Owenboy; Knockmoyle/Sheskin; The Gearagh; Mongan Bog; Clara Bog; Ballyteigue Burrow; Raheenmore Bog (see Fig. 12.1).

Biosphere Reserves

This is a designation established by the United Nations Educational, Scientific and Cultural Organisation (UNESCO) to set up a global network of reserves representing the world's ecosystems. A reserve "should combine nature conservation with scientific research, environmental monitoring, environmental training and education and local participation" (Griffin and Duggan, 1993). Two Irish sites, Killarney National Park and North Bull Island have been granted this designation.

The international conventions to which Ireland is a signatory State, or will be in the near future, together with those which are ratified by its membership of the EU are given in the box below.

International Conventions

The Ramsar Convention on Wetlands of international importance especially as Waterfowl Habitats was ratified by Ireland in 1984. Twenty-one wetland sites, totalling 12,500 ha, are designated under the Convention. These sites are all existing Nature Reserves owned by the State and are shown in Fig. 12.4.

The Bonn Convention on the Conservation of Migratory Species of Wild Animals was ratified in 1983. This Convention aims at protecting endangered or threatened species of fauna which migrate between different states. It is significant to Ireland especially in relation to the internationally important populations of ducks, geese, swans and waders.

The International Convention for the Regulation of Whaling was ratified by Ireland in 1985. In June 1995 over 300 delegates from all over the world attended the meeting of the International Whaling Commission, which was hosted by Ireland, at Dublin Castle. The International Whaling Commission was established after the Second World War as a result of growing concern regarding the over-exploitation of some whale species.

The Council of Europe's Bern Convention on the Conservation of European Wildlife and Natural Habitats was ratified in 1982. It was the first attempt formally to legislate for the protection of species and their habitats in Europe. It formed the basis for the subsequent habitats Directive. The habitats Directive goes further in that it establishes the principle of conserving natural habitats for their own sake and not only because they are home to certain species.

In June 1992, in Rio de Janeiro, the European Commission and the EU Member States jointly signed the Convention for the Maintenance of Biodiversity. The habitats and wild birds Directives are the EU's contribution to the maintenance of biodiversity as laid down by the Convention.

The provisions of the Washington Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) are implemented in Ireland, and the Convention is shortly to be ratified. Council Regulation EEC 3626/82 establishes a system of import/export licensing for all species and products thereof which are covered by the Convention.

RESEARCH AND CONSERVATION ACTION PROGRAMMES

1995 was designated 'European Nature Conservation Year' (ENCY '95) by the Council of Europe. The internationally accepted theme for ENCY '95 was 'Nature Outside Protected Areas'. The campaign focused on the need to conserve nature and the natural environment in the broader countryside and in urban areas. The main emphasis for ENCY '95 in Ireland was *Awareness and Action for Nature Conservation*, combined with the European theme of *Nature Outside Protected Areas*.

A series of baseline and repeat surveys on the status and distribution of certain bird species has been undertaken since the 1980s. The NPWS either initiates, encourages, supports or participates in these surveys alone or in partnership with other conservation organisations at home and abroad. Each survey has clearly defined objectives and methodologies which allow for the repetition of surveys at regular intervals. Repeat surveys make it possible, for example, to compare and measure changes in population size which is a primary indicator of the conservation status of the species.

An example of another research programme is the joint Dutch/Irish Peatland Research Project. The NPWS and its Dutch counterpart, in association with the Geological Survey of Ireland (GSI), has undertaken a major research project on the ecohydrological management of raised bogs. Work focused on Clara Bog and Raheenmore Bog Nature Reserves with a view to making recommendations for the conservation and restoration of raised bogs. Research was carried out over five years and consisted of topography and geology mapping, establishing hydrological monitoring systems and carrying out vegetation surveys with a view to making recommendations for the conservation and restoration of raised bogs. A report based on this research will be published in 1996.

Red Data Book Status Categories

Current information on endangered or vulnerable species is contained in the 'Red Data' books which have been compiled on an all-Ireland basis for vertebrates and vascular plants. The concept of a Red Data book has been defined as "a register of threatened wildlife that includes definitions of degrees of threat." In the Irish Red Data books the threat categories are as defined by the World Conservation Union (IUCN). The definitions are as follows:-

Extinct: Species not definitely located in the wild during the past 50 years (criterion as used by CITES). Taxa* which formerly had wild breeding populations in Ireland but which are now believed to have died out.

Endangered: Taxa in danger of extinction and whose survival is unlikely if the causal factors continue operating. Included are taxa whose numbers have been reduced to a critically low level or whose habitats are so drastically reduced that they are deemed to be in immediate danger of extinction.

Vulnerable: Taxa believed likely to move into the 'Endangered' category in the near future if the causal factors continue operating. Included are taxa of which most or all the populations are decreasing because of over-exploitation, extensive destruction of habitat or other environmental disturbance; taxa with populations that have been seriously depleted and whose ultimate security has not yet been assured; and taxa with populations that are still abundant but are under threat from severe adverse factors throughout their range.

Rare: Taxa with small populations that are not at present 'Endangered' or 'Vulnerable', but are at risk. These taxa are usually localised within restricted geographical areas or habitats or are thinly scattered over a more extensive range.

Indeterminate: Taxa known to be 'Endangered' or 'Vulnerable' or 'Rare' but where there is not enough information to say which of the three categories are appropriate.

The IUCN categories have been recently modified (1995) but the modifications have yet to be applied to Irish data.

*Taxa = a general term for taxonomic groups, whatever their rank.

Protected and Rare Flora

According to the IUCN/WWF Plant Advisory Group, as many as 60,000 plant species, approximately one in five of the world's total, are estimated to become extinct by the year 2050 if present trends continue (Curtis and McGough, 1988). Europe contains some 11,000 species of vascular plants of which 1,500 are considered threatened. Ireland has 1,309 vascular plants, at least 815 of which are undoubtedly native species. The Irish Red Data Book for Vascular Plants was published by the then Wildlife Service in 1988 (Curtis and McGough, 1988). Of the 159 vascular plant species recorded in that Red Data Book (6 per cent of total species in Ireland) ten are thought to be extinct. This represents 0.76 per cent of the total vascular flora in Ireland.

The number of species of flowering plants known in Ireland and the number of species threatened (Table 12.1) as defined by the Flora (Protection) Order, 1987, made under the Wildlife Act, 1976, can be listed as follows (Griffin and Duggan, 1993):

Number of species known 815;
Number of species threatened 68 (8.3 per cent).

However, 149 species of flowering plants were assigned to a category of threat, ranging from Endangered to Indeterminate, in the Irish Red Data Book (Curtis and McGough, 1988). The most threatened or endangered species are outlined in the box below. Ongoing inventory and monitoring work has been carried out on Ireland's protected and threatened flowering plants since the publication of the Red Data Book. Research and data collation which began in 1988 resulted in the publication of a joint British and Irish Red Data Book for Stoneworts (Stewart and Church, 1992). Although there are only 33 species of these aquatic algae in Britain and Ireland, they have great ecological significance. At least ten of the 25 Irish stonewort species are considered to be threatened and two of these are extinct. Red Data books are currently being prepared for bryophytes and lichens; two areas in the south-west, Glengarriff and Killarney, are rich in bryophyte and lichen species of extreme oceanic and even tropical distribution. Two bryophytes which occur in Ireland, *Drepanocladus vernicosus* and *Petalophyllum ralfsii*, are listed in the habitats Directive (see Appendix 12.1).

Endangered Vascular Plant Species

Six species are in danger of extinction and their survival is unlikely if the causal factors continue to operate. Three Endangered species are from the Wetland group; two of these are from bogs, the marsh saxifrage (*Saxifraga hirculus*) and the serrated wintergreen (*Orthilia*

secunda) and have declined as a result of the destruction of their peatland habitat. *Orthilia secunda* is already extinct in the State for that reason. The remaining wetland species is the meadow saffron, (*Colchicum autumnale*), whose decline seems attributable to loss of habitat due to intensive farming use of the seasonally wet, old meadows in which the species occurred. Cottonweed (*Otanthus maritimus*) is the single Endangered coastal species and its decline may be due to climatic reasons. Rough poppy (*Papaver hybridum*), the Endangered arable weed species, was thought to be extinct until it was re-found in north County Dublin in 1985. The reasons for its decline include better screening methods, increased use of herbicides and, most importantly, the decline in area under tillage in favour of pasture and silage making. The remaining Endangered species, meadow saxifrage (*Saxifraga granulata*), is declining for a number of reasons, highest among these being the pressures caused by modern agriculture and amenity on its habitats.

(Source: Curtis and McGough, 1988 with the addition of vernacular names from Scannell and Synnott, 1987)

The prevailing warm westerly winds, the associated frequent precipitation and high atmospheric humidity, the ameliorating effects of the Gulf Stream and the narrow annual range in temperature combine to provide Ireland with an equable oceanic climate; the flora is mainly oceanic or 'Atlantic' but heterogeneous elements of great phytogeographic interest also occur. Certain regions in Ireland such as Killarney, the Burren, Roundstone and Ben Bulbin are famous for their rare plants (Webb, 1963). The Burren has an abundant vegetation with a remarkable diversity of flora for a seemingly bare hilly area (Scannell and Synnott, 1972) where plants of the high alps, mountain avens (*Dryas octopetala*) and spring gentians (*Gentiana verna*), grow at sea-level with plants of the Mediterranean basin, dense-flowered orchids (*Neotinea maculata*) and maidenhair ferns (*Adiantum capillus-veneris*); it has, for this reason, been described as a 'botanical metropolis' (Whittow, 1975) while the appellation of 'botanical museum' has also been applied (Freeman, 1950).

Turloughs, which are unknown outside Ireland, are found in several counties but are especially abundant in Clare and south-east Galway and these have a characteristic flora (Scannell and Synnott, 1972) including silverweed (*Potentilla anserina*), the moss *Cinclidotis fontinaloides* and of particular interest the fen violet (*Viola persicifolia*). Eskers, drumlins and end moraines are notable features of the Irish landscape and support calcicole plants while the bogs characteristically have a calcifuge flora.

Table 12.3 Plants Found in Ireland and not in Britain with an Indication of their Nearest Known Station Outside Ireland (after Webb, 1983 with vernacular names from Scannell and Synnott, 1987).

Species name	Vernacular name	Nearest station outside Ireland
<i>Arbutus unedo</i>	Strawberry tree	Brittany
<i>Arenaria ciliata</i>	Fringed sandwort	Jura
<i>Daboecia cantabrica</i>	St. Dabeoc's heath	West France
* <i>Erica erigena</i>	Irish heath	West France
* <i>Erica mackaiana</i>	Mackay's heath	North-west Spain
<i>Euphrasia salisburgensis</i>	Irish eyebright	Vosges
* <i>Hypericum canadense</i>	Irish St. John's wort	Newfoundland
<i>Inula salicina</i>	Irish fleabane	Normandy
<i>Minuartia recurva</i>	Recurved sandwort	North-east Portugal
<i>Neotinea maculata</i>	Dense-flowered orchid	Isle of Man (North Spain)
<i>Pinguicula grandiflora</i>	Large flowered butterwort	North Spain
<i>Saxifraga hirsuta</i>	Kidney saxifrage	North Spain
<i>Saxifraga spathularis</i>	St. Patrick's cabbage	North-west Spain
<i>Simethis planifolis</i>	Kerry lily	Brittany (West France)
* <i>Sisyrinchium bermudiana</i>	Blue-eyed grass	Newfoundland

*There are doubts regarding the native status of some of these plants.

Of particular botanical and biogeographical interest are the 15 plant species which occur in Ireland but not in Britain; of these, eight are of Atlantic or Mediterranean-Atlantic range, four are what could be called 'broadly alpine', two are primarily North American and one is central European (Webb, 1983). They are listed in Table 12.3 together with their nearest known station outside Ireland.

Protected and Rare Fauna

An Irish Red Data Book, covering the whole island, was published recently for vertebrates (i.e., animals with a backbone) including mammals, birds, amphibians and fish (Whilde, 1993). Of the 230 vertebrate species which have regularly occurred in Ireland, the Red Data Book features 68 species, including seven extinct, 42 threatened and 19 others (see Table 12.4).

Table 12.4 Number of Fauna Species in the Various Categories of Threat in Ireland (Whilde, 1993).

Threat category*	Ex	E	V	R	I
Mammals	1	0	0	1	2
Birds	6	8	3	15	3
Reptiles	0	0	0	0	0
Amphibians	0	1	0	0	0
Fish	0	3	3	0	3
Total	7	12	6	16	8

*Ex = extinct; E = endangered; V = vulnerable; R = rare; I = indeterminate

The pine marten (*Martes martes*) (see box) is regarded as the rarest of all the Irish mammals (e.g., Fairley, 1984) but in fact that status belongs to the black rat (*Rattus rattus*) though it is unlikely that many will be championing its cause. The black rat, infamous for carrying the flea which spreads bubonic plague, is not an old native (Praeger, 1950) but thrived in Ireland for many centuries, until ousted by the brown rat (*Rattus norvegicus*) which, since its arrival in the eighteenth century, has rightly been regarded as the country's greatest animal pest. There is a parallel between these two and another pair of related rodents, i.e., the red squirrel (*Sciurus vulgaris*) and the grey squirrel (*Sciurus carolinensis*): the red squirrel, whose skins were exported until the middle of the seventeenth century appeared to have become extinct in Ireland but was reintroduced about the beginning of the nineteenth and spread into every county (Praeger, 1950); the grey, which was introduced in 1911, may have displaced the native squirrel from some areas although the evidence is not conclusive; what is clear, however, is that when reds die out in an area and greys establish themselves, recolonisation by the former is prevented (Fairley, 1984).

Endangered Fauna Species (Whilde, 1993).

Birds: common scoter, hen harrier, grey partridge, corncrake, red-necked phalarope, nightjar, roseate tern and corn bunting.

Fishes: allis shad, Killarney shad and pollan.

Amphibian: natterjack toad.

Pine Marten (*Martes martes*)

Apart from the now extinct wolf (*Canis lupus*) the animal which has probably suffered most at the hands of man in Ireland, and still regarded as a pest in some quarters, is the pine marten. According to Fairley (1983) the marten was almost certainly present in every county in the middle of the last century. The nineteenth-century natural historian Alexander More (1830-1895), however, noted that it was becoming rare, particularly in Clare, a hundred years ago (Moffat, 1898). Apparently increasing again in both numbers and range it is considered secure, particularly since the laying of strychnine has been banned (Whilde, 1993). Statutory protection, however, is no guarantee of survival and it appears to have died out in England despite being fully protected there since 1981 (Anon., 1994).

The fox (*Vulpes vulpes*), the badger (*Meles meles*) and the stoat (*Mustela erminea*) are all widespread and numerous mammals. In Ireland, uniquely among western European countries, the otter (*Lutra lutra*) is still relatively plentiful. The Irish stoat (*M. erminea*) and Irish hare (*Lepus timidus*), show the most interesting examples of native development of variation among the mammals present on the island; the Irish hare is a subspecies of the arctic hare and is widely spread while the other, the brown hare (*Lepus capensis*), which was introduced, apparently only occurs in the extreme north-west (Fairley, 1984). Another protected species, the pygmy shrew (*Sorex minutus*), the smallest mammal found, vies with the field mouse (*Apodemus sylvaticus*) for the status of the commonest Irish mammal; the former is an insectivore, like the hedgehog (*Erinaceus europaeus*) and not a rodent like the latter. Seven bat species are present in Ireland and all are widely distributed except for the lesser horseshoe (*Rhinolophus hipposideros*) which is confined to an area along the west and south-west coasts (O'Sullivan, 1994).

The Cetacea (whales, dolphins and porpoises) of Ireland's territorial waters are included among its mammalian fauna and, as already stated, these waters have, since 1991, been designated a Whale and Dolphin Sanctuary through a combination of the Whale Fisheries Act and the Wildlife Act. Seals are also considered among the mammals of Ireland and the two species occurring around the coast, the grey seal (*Halichoerus grypus*) and the common seal (*Phoco vitulina*) are also protected by the Wildlife Act.

Apart from the marine turtles which may visit its offshore waters Ireland has only one species of reptile, the common lizard (*Lacerta vivipara*), which is now less common

apparently, than formerly; it is protected under the Wildlife Act as are the vagrant turtles. Fishermen release turtles that are occasionally caught in fishing gear. Stranded turtles normally expire and others may meet with accidents. An example of the latter occurred in August 1993 when a dead female leathery turtle (*Dermochelys coriacea*) was found entangled in a lobster pot line off Crookhaven, Co. Cork (Berrow and Rogan, 1995).

Due to a wide range of factors including habitat loss, reduction in food supplies, predation and poisonings from pesticides, some bird species in Ireland have suffered a dramatic decline in numbers over the past few decades. At present in Ireland there are eight bird species listed as endangered in the Irish Red Data Book (Whilde, 1993). In response to these reductions various efforts have been made to either halt the declines or increase bird population numbers. Two examples of endangered bird species, the corncrake and roseate tern, are profiled in the box below.

Birds

Corncrake (*Crex crex*)



The corncrake is a rapidly declining summer visitor and the only extant summer Irish bird listed as 'Rare' on a world-wide scale by the World Conservation Union (IUCN). A survey of the corncrake population of Ireland in 1993 indicated a total of 174 calling males, a decline of 81 per cent since 1988 (Sheppard and Green, 1994). In 1994 numbers fell to just 130 calling males (IWC, 1994). The loss of suitable habitats and the destruction of females, nests and young caused by mechanisation of hay cutting, early hay cutting, and during the past twenty years, the cutting of silage instead of hay has led to this dramatic decline in population numbers. In Ireland the corncrake is now confined mainly to the Shannon valley, the area west of the River Shannon and the north-west. The Irish Wildbird Conservancy (IWC) is at present implementing an Emergency Action Plan for this

endangered species. Efforts to prevent the decline have involved persuasion, and latterly payment to farmers, under the corncrake grant schemes, to delay mowing until the first day of August to decrease mortality and nest losses and to mow from the centre of the field outwards to reduce losses of chicks (Sheppard and Green, 1994). These measures appear to have helped the corncrake as the numbers for the IWC census in 1995 show an increase for the first time since the 1960s (Casey, 1995); the cost of the measures was some £100,000, £65,000 of which was provided by the exchequer and the remainder by the Royal Society for the Protection of Birds.

Roseate Tern (*Sterna dougalli*)



The roseate tern is a rare breeding species. The numbers declined through the 1960s and 1970s bringing the population down to 268 pairs by 1984; in recent years there has been a revival with 426 pairs being recorded in 1991. The majority of the population in Ireland now breeds at two sites, Rockabill Co. Dublin and Lady's Island, Co. Wexford; these two sites held 533 pairs between them in 1994, the highest since 1989 (IWC, 1994). There are also a few nesting sites in the north-east of the country and some on the west coast islands. A number of conservation efforts have been undertaken to conserve this bird species. With the automation of the lighthouse on Rockabill in 1989, a collaborative protection scheme between the IWC and the National Parks and Wildlife Service was undertaken. This includes wardening and the provision of nest boxes on the island during the breeding season, culling predators prior to the arrival of the terns, scaring gulls during the nesting period and the prevention of disturbance by human visitors. This has been very successful with numbers having risen to 427 pairs in 1993 (Coveney, 1995); in 1995 this record number was exceeded with 550 pairs being recorded and a significant increase in the number of eggs being laid and chicks hatching also reported (NPWS). At Lady's Island Lake the culling of large gulls and the control of cats,

foxes, feral mink and a badger has led to an increase in numbers to 140 pairs (Coveney, 1995) and the breeding success of the terns (Whilde, 1993).

The only amphibian classified as endangered in the Irish Red Data Book is the natterjack toad (*Bufo calamita*); only two other species, the common frog (*Rana temporaria*) and common (or smooth) newt (*Triturus vulgaris*), occur in Ireland and all three are protected under the Wildlife Act.

Natterjack Toad (*Bufo calamita*)

The natterjack toad is the only toad found in Ireland and the rarest amphibian. It occurs in just one small area in Kerry where it lives in coastal sand dunes and breeds in lakes, pools and drains containing water which ranges from fresh to brackish. A survey carried out in 1984 located 115 adults. Its population is so small and declining to such an extent that it is now considered to be seriously endangered and facing the prospect of extinction by the year 2000 unless immediate conservation action is taken.

Various factors have contributed to this decline; natural threats include the inundation of breeding waters by sea water, pond desiccation, the destruction of sand dunes and predation of adults by birds, fish and rats. The major current threats are from recreational and tourism developments.

The natterjack toad is protected under the Wildlife Act but many of the habitats of the remaining viable colonies are not, however, protected by existing legislation. A case involving a planning application to extend a golf course was brought before the Bern Convention Committee in 1991. The subsequent report advised that there should be no further extension of the golf course and that any future golf courses and developments should be directed to sites of low biological interest. The report also recommended that the State programme of translocation of natterjack toads from the Kerry site to another location in Kerry and two dune systems (Nature Reserves) in Wexford should be continued.

(Source: NPWS)

Included among the freshwater fish in Ireland which have declined in numbers or whose status is rare or largely unknown can be mentioned the arctic char (*Salvelinus alpinus*), the twaite shad (*Alosa fallax*) and its land-locked subspecies the goureen or Killarney shad (*Alosa fallax killarnensis*) which is only found in Lough Leane

(O'Maoileidigh *et al.*, 1988). The smelt (*Osmerus eperlanus*), although abundant in the Shannon estuary, and which also occurs in the Foyle, is apparently not found elsewhere in Ireland (Went and Kennedy, 1976); there have been occasional records from the Waterford estuary but with no evidence of spawning (Fitzmaurice, P. pers. comm.). The pollan (*Coregonus autumnalis*) despite only occurring in four lakes in Ireland, Loughs Neagh, Erne, Ree and Derg, has received little conservation attention even though these are the only populations of this species in western Europe (Maitland and Lyle, 1990). The allis shad (*Alosa alosa*) like the sturgeon (*Acipenser sturio*) is rarely seen in estuaries or rivers in Ireland and probably was always a rare vagrant. Some of these species, *Alosa* spp., *A. sturio* and the lampreys as well as the salmon are listed in the habitats Directive (see Appendix 12.1). No fish are protected under the Wildlife Act but this could be used to protect threatened species and their habitats by designating Nature Reserves. Freshwater fish legislation in Ireland e.g., Live Fish (Restriction on Import) Order, 1972 has traditionally been aimed at conservation of fish as an exploitable resource rather than as elements of the native fauna (Maitland and Cambell, 1992) but has been instrumental in preventing the introduction of undesirable species and diseases. With regard to candidates for conservation and protection, the char, twaite shad (particularly the goureen), smelt and the pollan would seem to be priority species. The Red Data Book (Whilde, 1993), as well as recognising the salmon (*Salmo salar*) as an internationally important species, lists nine species as threatened in Ireland, viz. *Endangered*: allis shad, Killarney shad and pollan; *Vulnerable*: twaite shad, arctic char and smelt; *Indeterminate*: sea lamprey (*Petromyzon marinus*), river lamprey (*Lampetra fluviatilis*) and brook lamprey (*Lampetra planeri*). The opinion from the Central Fisheries Board is that the char should now be added to the endangered species list and that the lakes where it still occurs should be designated as NHAs (Fitzmaurice, P. pers. comm.) (See also Chapter 9).

While there is no Irish Red Data Book for invertebrate animals, there is a list of taxonomic groups considered sufficiently well known for an assessment of their status in Ireland to be made and for policies on their conservation to be adopted. With effect from 1 June 1990 three invertebrate species became protected within the meaning of the Wildlife Act, (Protection of Wild Animals Regulations, S.I. No. 112 of 1990). Two of these are freshwater species, the pearl mussel and crayfish, and the other is the Kerry slug; the need to protect all three is recognised internationally by their inclusion on Appendix III of the Bern Convention and Annex II of the habitats Directive. The scheduling of some species, such as the crayfish and pearl mussel, for statutory protection, however, does present a problem with enforcement. Four other invertebrate species, three semi-aquatic snails and a

butterfly, which occur in Ireland are also listed in the habitats Directive (see Appendix 12.1).

Invertebrates

Kerry Slug (*Geomalacus maculosus*)

The "spotted slug" of Kerry occurs in three protected sites in Ireland: Glengarriff Forest, Uragh Wood Nature Reserve and the Killarney National Park. All Irish records are from the Devonian Old Red Sandstone areas of west Cork and Kerry where it has been found in 38 different 10 km grid squares; it also occurs on Cape Clear Island off the Cork coast (Greenwood, 1973) the most southerly point in Ireland. There is no evidence that there has been any contraction in range since its discovery, near Caragh Lake, in 1842. Elsewhere it is confirmed only from parts of northern Spain and Portugal. Little is known of its site requirements so that it "is threatened as much by our ignorance of how to protect it as by lack of habitat" (Platts and Speight, 1988).

Freshwater Pearl Mussel (*Margaritifera margaritifera*)

The pearl mussel has an extensive distribution worldwide but has declined throughout its natural range as a result of pollution, habitat destruction and overfishing for its pearls. It is widely spread in Ireland and shows greatest expression in the south-west but has become extinct in some of its former known sites (Lucey, 1993). In surveys conducted between 1990 and 1992 of over 177 sites covering all major river systems in Northern Ireland *Margaritifera* populations were restricted to fewer than 20 sites in river systems which formerly supported vast numbers of mussels (Roberts and Mackie, in press); it is, however, still relatively common in Donegal in the north-west. The large populations of *M. margaritifera* in Ireland may comprise one of the last strongholds of the species in Europe, given its extinction or terminal decline in most European countries (Ross, 1990).

Freshwater Crayfish (*Austropotamobius pallipes*)

The crayfish is relatively common and widely distributed in limestone rivers and lakes in Ireland (Lucey and McGarrigle, 1987) but is under threat from a lethal fungal disease which has devastated native stocks throughout Britain and Europe. This so-called crayfish plague was introduced to the affected countries through immune alien species used for aquaculture. Although the Irish authorities have always operated an import policy that excludes all non-native species, this disease was diagnosed, without isolating the causative organism, as being responsible for the collapse of some Irish lake populations (Matthews and Reynolds, 1990).

If the disease has reached Ireland then its effects have been far less severe than in other countries. The Irish crayfish populations probably represent the largest reservoir of the species in Europe.

Coastal Zone Research and Management

Ireland, despite its small size, possesses a coastline which, because of its highly indented nature, is surprisingly long, exceeding, for example, that of France. A total of 168 sand systems have been identified in the State, with a clear concentration of these systems in the north-west. An inventory of sand dunes in Ireland has been published as well as an account of the vegetation of Irish dune systems and an inventory of the salt-marshes of Ireland. The area of intact dunes remaining in Ireland is now reaching a critical level in terms of what is required to maintain the range and diversity of types for conservation. Machairs and fixed dunes in Ireland are listed as priority habitats for conservation under the habitats Directive (see Appendix 12.1).

A consultant has been commissioned, by the Minister for the Environment, the Minister for the Marine and the Minister for Arts, Culture and the Gaeltacht, to prepare a strategy document on Coastal Zone Management in Ireland from which the Government will formulate national policies (see Chapter 10).

There is a need for the status of *Lithothamnion* deposits (calcareous deposits associated with this seaweed) along the Atlantic coast to be established. Such coral type deposits can give rise to beach sands containing over 90 per cent of carbonate and have been used as an agricultural fertiliser. Because of the poor regeneration capacity after dredging, however, some conservation of these examples of temperate carbonate production, which are of considerable geological interest, might be necessary.

Other Research

Other ongoing research programmes include genetic research for the purposes of establishing long-term conservation strategies, invertebrate research, surveys of seals and other sea mammals, badgers and deer. An international designation group representing NPWS, the Department of the Environment for Northern Ireland and the Joint Nature Conservancy Committee (UK) meets regularly to discuss and plan projects of common interest.

CONFLICTS

Some of the most serious conflicts which arise between development and wildlife conservation are as outlined below.

Overgrazing and Wildlife

The gross overstocking of sheep arose as a result of EU-funded livestock headage payments which were made to farmers in an attempt to maintain farming and rural populations in disadvantaged regions. As payments are based on the number of stock carried, this led to a large increase in sheep numbers. Figures produced by the Central Statistics Office (CSO) show that nationally, sheep numbers more than doubled from 3.3 million in 1980 to 8.8 million in 1991 (Chapter 2). This increase has resulted in extensive overgrazing problems in Ireland. Overgrazing particularly affects peatlands, heaths and coastal habitats, with the loss of characteristic and rare flora and fauna. It is most noticeable in the Disadvantaged Areas particularly the mountainous regions of Counties Donegal, Mayo, Galway and Kerry. Important habitats for many of Ireland's upland bird species have been severely damaged as a direct result of excessive sheep-stocking densities in hill and mountain areas. In particular red grouse, golden plover and the hen harrier have been affected by this problem (Murphy, 1995). The accelerated erosion of peat, due to overgrazing, can also cause problems in the aquatic environment by reducing light and oxygen and inhibiting algal and other plant productivity; peat silt can directly affect species such as the protected freshwater pearl mussel and has indirectly caused mortality of between 20,000 and 30,000 eggs in a fish hatchery (Douglas, 1995).

The Common Agricultural Policy (CAP) reform measures, which became effective in January 1993, introduced individual quotas in the case of the Ewe Premium Scheme based on 1991 flock numbers. From 1992 to 1993 there was a net drop in sheep numbers of 2.3 per cent. This was the first decrease in ewe numbers since 1978 and may be taken as an indication of the initial effects of the quota; the decrease, however, is too small to have an impact on the overgrazing problem. It was hoped that the introduction of the Rural Environmental Protection Scheme (REPS) which provides payments to farmers for adopting conservation-friendly farming practices and protecting wildlife habitats would help to alleviate this problem. The Supplementary Measure in the REPS Scheme, dealing with degraded areas has not, to date, had the desired effect as the take up on this measure, in the areas of greatest need, has not been great. The Department of Agriculture, Food and Forestry has got the approval of the European Commission to have the Scheme modified to make it more attractive in these degraded areas. The minor decrease in the national sheep flock, indicated by CSO figures, clearly shows that more has to be done if the overgrazing problem is to be solved.

Aquaculture and Wildlife

Shellfish cultivation is generally regarded as a relatively benign activity from a wildlife conservation point of view although it can have other impacts. However, the disturbance level and interference with food sources caused by intensive fin fish aquaculture operations can conflict with the protection of marine life. For example, in poor dispersal conditions waste matter originating from faeces and uneaten food can accumulate on the sea bed under fish cages. This can lead to a deoxygenation of the sediment and a corresponding reduction in species diversity. Recent changes such as reduced food wastage, fallowing (movement of cage position) and the use of more exposed sites has reduced the potential for damage. While some locations can support a certain level of aquaculture within or adjacent to SPAs for birds, acceptable levels are not easy to ascertain. Research is being carried out in this area, the outcome of which should help to balance the interests of nature conservation and aquaculture development. The decline of sea-trout in the west and south-west in recent years has caused conflict between anglers and salmon farmers; the former blamed the latter for falling stocks citing the increased sea-lice infestation as the causative agent (see Chapter 9). Fairly recently, in 1991, the unauthorised release of a large number of Danube Salmon or Huchen (*Hucho hucho*) into the River Barrow, apparently when a prospective fish farming venture was abandoned, raised fears that indigenous salmon could be threatened (Anon., 1991) but all previous introductions of this species into the British Isles have seemingly proved unsuccessful (Maitland and Cambell, 1992).

Afforestation and Wildlife

It is EU policy that grant-aided afforestation must be compatible with environmental protection. Afforestation which causes damaging effects to areas of ecological conservation value is not eligible for grant aid. Blanket Bog is the main habitat under threat from such activity. It is a particular provision of the CAP Afforestation Scheme 1994-1997 that areas which are protected or qualify for protection under the wild birds Directive or habitats Directive are not eligible for grant aid. The NPWS is consulted in relation to grant applications in proposed NHAs. Environmental Impact Assessment (EIA) is required for planting projects of 200 ha or more or for the replacement of broadleaf high forest with conifers. This threshold level for afforestation is regarded as being too high to be effective from a nature conservation point of view and is currently being reviewed by the Department of the Environment and the Forest Service.

Recreation and Wildlife

Certain recreational developments, such as golf courses, have resulted in ecological destruction of sites of international conservation value, especially machair sand dune systems. The landform and vegetation complexes of machairs have evolved over thousands of years. Any structural or ecological alteration - a common consequence of golf course development - greatly reduces or destroys this value. Up until May 1994 golf course developments did not require planning permission, as a result of which many internationally important sand dune areas were lost to golf course developments. Golf course construction is now subject to planning permission. This will ensure that in future such development proposals can be scrutinised for their ecological impacts, and that those impacts will be taken into account by the planning authorities when deciding on planning applications.

Commercial Peat Cutting and Wildlife

The conservation of peatland is primarily for its unique flora. Bord na Mona and the NPWS have an agreement whereby the former does not exploit peatlands that are of conservation value. Up to the end of 1993 a total of 3,857 ha of peatland was sold by Bord na Mona to the NPWS for conservation. However, the NPWS has no means of preventing the exploitation of bogs where the turbary rights are privately owned, except by acquisition of the sites, and the commercial value of these is often prohibitive. The threshold for peat production beyond which developers must carry out an EIA is 50 hectares. This is considered, by the NPWS, to be too high to benefit nature conservation and needs to be reduced. Desirable changes are understood to be imminent. Ireland is obliged under the habitats Directive to conserve the best examples of priority habitats, including peatlands.

Drainage and Wildlife

Arterial drainage, which is a function of the OPW, entails the deepening and widening of river channels to accommodate existing river flow in order to reduce flooding and to facilitate field drainage. In order to avoid or minimise adverse environmental impacts, such as the loss of wetlands of ecological importance, the disturbance and loss of spawning areas for trout and salmon and reduction in the number and variety of riverside habitats, it is customary during the planning of schemes to give detailed consideration to the works methods to be employed and to the scheduling of works. Unfortunately, this was not always done in the early years (1950s, 1960s and 1970s) of drainage schemes when severe environmental impact was wrought on many rivers. Nowadays, in many instances entire areas are omitted from schemes where such adverse

impacts would be otherwise unavoidable. Prior to the reform of the CAP there was economic pressure on landowners to drain wetlands. Reform of the CAP and subsequent moves toward more extensification in agriculture and 'set-aside' policies have reduced the pressures on wetlands.

Wind Farms and Wildlife

The introduction of wind farming in Ireland is generally welcomed as a partial substitution for combustion of non-renewable coal, oil, gas and peat. From a wildlife conservation point of view wind farm developments may have adverse effects at the site of construction, where these sites lie within Natural Heritage Areas, or where the location of a turbine may affect adjacent bird habitats or flight paths. While an EIA is not a requirement for such developments, detailed information on the environmental impact of a proposed development is likely to be necessary for a planning authority to assess a planning application and developers should be encouraged to provide a statement of the range of likely impacts of a development as part of their planning application.

Pollution and Wildlife

Changes in water quality, contamination from chemicals and pesticides as well as oil pollution are all potential or actual threats to wildlife species. The eutrophication of lowland rivers and lakes is thought to have affected breeding water birds and aquatic species. Fish species, such as arctic char and smelt, are particularly susceptible to water-borne pollution whether from agricultural, industrial or domestic sources. Chemical treatment of timber in buildings is known to affect bats; while herbicides and insecticides affect the grey partridge and barn owl. Although there has been little damage by oil pollution, there is a considerable risk potential to wintering wildfowl and waders, otters, breeding sea birds and fish in the event of oil spillage.

Natural Threats to Wildlife

The spread of introduced species is usually at the expense, and may even cause the extinction, of native species. The classic example has been the spread of *Rhododendron ponticum* in the natural oakwood in Killarney at the expense of native shrubs (Kelly, 1981). According to some experts (e.g., Thompson, 1990) a causal link between wader decline and the spread of *Spartina anglica* has not been established by replicated, experimental trials. The spread of *Spartina* in many estuaries, however, is reported to have serious implications for wintering wildfowl and waders whose mudflat feeding habitat is reduced as this vigorous alien grass takes over (Nairn, 1986). The spread of feral mink (*Mustela vison*) can have a serious effect on breeding ducks, terns and waders due to predation. The giant hogweed

(*Heracleum mantegazzianum*), which was introduced from the Russian Caucasus in the nineteenth century as a garden ornamental, has become naturalized and reached pest status in some areas. For a variety of reasons the giant hogweed has been targeted as an undesirable plant but in a survey of its occurrence in southern counties its growth was considered to be at pest proportions in only one area with very little evidence of new invasions in the region in the last decade (Lucey, 1994). One of the most recent unwelcome arrivals in Ireland, the New Zealand flatworm (*Artioposthia triangulata*), has the potential for causing widespread ecological damage as it appears to prey selectively on earthworms.

New Zealand Flatworm (*Artioposthia triangulata*)

Since first being discovered in Northern Ireland in 1963 (Blackshaw, 1992), this flatworm has spread southward and has been found in Donegal, Cavan, Leitrim, Dublin, Kildare, Kilkenny and west Cork; it has recently been found in a Co. Galway garden centre (McCarthy, 1995) and trading in plants may well have been the source of its original introduction and subsequent widespread distribution in Ireland. Because it feeds on earthworms, which are vital to soil fertility, nutrient cycling and the breakdown of organic matter, *A. triangulata* may pose a serious threat to Irish agriculture. Studies have revealed that it can have an impact on all species of earthworm but those found near the soil surface are more vulnerable (Blackshaw, 1992). Research on methods of control, including chemical and biological, is continuing in Northern Ireland.

LAND ACQUISITION FOR CONSERVATION

One of Ireland's most precious resources, from a nature conservation standpoint, is its peatlands. Except for Canada and Finland, Ireland has proportionally more bog than any other country in the world. Originally, the total area of raised bog in the country was 311,300 ha; the raised bogs of conservation importance now remaining amount to 99 sites covering 17,970 ha. The original area of blanket bog in the country was 774,990 ha; it is estimated that 112,304 ha of conservation importance now remain (IPCC, 1992).

The NPWS acquisition programme for conservation currently concentrates largely on peatlands. Co-financing from the EU ranges from 50 to 85 per cent depending on the habitat type. It is the policy of the NPWS to make full use of all the EU funding available for land acquisition. Further funds were spent during the period from 1990 to 1994 on acquiring sporting, grazing and turbarry rights within areas of ecological conservation value.

EDUCATION

Education in, and public awareness of, matters affecting wildlife and habitats are essential for nature conservation. 1995 was designated European Nature Conservation Year by the Council of Europe and the internationally accepted theme was "Nature Outside Protected Areas", with Member States emphasising and promoting awareness of nature in the broader countryside and urban environment. The NPWS offers literature, advice and information on request to the general public, as well as giving talks, visual information, field trips and lectures to various bodies, including schools, nature groups and farming interests. Non-Governmental conservation organisations also provide an invaluable contribution in the area of education and publicity.

The number of tourists visiting Heritage Sites has in general steadily increased over the past ten years. This trend is illustrated by the following (mainly historic buildings):

Site	No. of visitors in 1985	No. of visitors in 1994
Aughnanure Castle	4,268	24,081
Charles Fort	13,901	33,296
Clonmacnoise	31,471	118,157
Derrynane House	10,262	16,673
Dublin Castle	62,674	122,479
Dunmore Cave	22,334	32,391

(Source: NPWS)

ENFO, the public information service on environmental matters, includes nature conservation aspects in its work.

In September 1995 An Post released a set of four new postage stamps depicting Ireland's only land reptile and its three amphibians. This represented the Irish Post Office's eighteenth annual Fauna and Flora issue.

INFORMATION GAPS

Major research is required into the ecological requirements of plant communities in general, in order to be able to assess accurately the environmental impact of various developments on these communities. Such data would also provide a useful monitoring and management tool. The effects of aquaculture on the coastal zone are not fully established as yet. Distribution, habitat and abundance data are required for many of the more elusive wildlife species, such as the otter, barn owl (*Tyto alba*) and hen harrier (*Circus cyaneus*), as well as for some freshwater fish species, moorland birds, birds of marginal farmland, certain wetland species and birds of 'damp' grasslands. Most habitats except

bogs, turloughs and some coastal types require surveys to map distribution and assess quality. In the meantime, the status of many NHAs is questionable. Information is needed on contaminant levels in fauna.

CONCLUSIONS

Perhaps the greatest achievement in the nature conservation field in the past ten years has been the apparent halting of the terminal decline of two species in particular, the corncrake and pine marten, which seem to have been saved, at least *pro tempore*, from extinction. However, it appears that a fish species, the char, has become extinct in Lough Conn in the same period which, coupled with its disappearance from three other lakes, Loughs Ennell, Owel (Central Fisheries Board, 1986), and Allua (Went, 1946) since the early part of this century, gives cause for concern. Updated work on the distribution and biology of char in Ireland is required to establish if the 20 or so other lakes which supported this relict species before 1930 (Went and Kennedy, 1976) still do and to try to establish the factors which appear to be working against it. Went (1971) as well as citing the demise of the species from Lough Neagh, in the early part of the nineteenth century, listed 17 other localities from where it had possibly become extinct in Ireland. Another fish species, the sea-trout, which is a migratory form of the brown trout (*Salmo trutta*), suffered a severe decline in numbers returning to some rivers in the west and south-west during recent years but the situation appears to have improved somewhat in 1994/95 (See also Chapter 9).

Other successes, at a species level, include the Greenland white-fronted goose (*Anser albifrons flavirostris*) and the peregrine falcon (*Falco peregrinus*). The former, which breeds in west Greenland and winters exclusively in Britain and Ireland, has since the introduction, more than a decade ago, of a moratorium on its shooting, increased substantially in numbers from a course of substantial decline (Fox *et al.*, 1994). The latter species had declined worldwide and had become locally extinct between the 1940s and 1970s, because of contamination by organochlorine insecticides. However, it has shown an increase of at least 23-26 per cent in breeding populations here between 1981 and 1991 (Norriss, 1995). A trend which has become apparent is an increase in breeding density of peregrines along routes taken by racing pigeons, when many can be killed or maimed, and is an example of conflict where the wildlife is seen as a perpetrator, at least by the pigeon fancier. Other examples of conflicts, involving wildlife species, with a negative aspect would include seals with fishermen, foxes with farmers and cormorants/herons with anglers/fish farmers (due to predation of either quarry or livestock) as well as badgers with farmers due to the perceived association with the spread of bovine tuberculosis.

One of the greatest controversies of the decade has been over the proposed establishment of visitor interpretative centres at natural heritage sites. Plans to build two, at the Burren in Co. Clare and Luggala in Co. Wicklow, were abandoned following opposition, which included litigation, from conservationists. Hare coursing and, to a lesser extent, fox hunting are controversial aspects of Irish sporting life and attempts, by the anti-blood sports lobby, to have legislation outlawing such pursuits passed by Dáil Éireann have so far failed to gain majority backing.

Many positive conservation developments in Ireland over the last decade have been as a result of membership of the EU. It is somewhat ironic, therefore, that one of the chief threats to landscape and wildlife in Ireland should be from modern agricultural practices which are a result of CAP. The CAP reform measures, which became effective at the beginning of 1993, did, and will hopefully continue to, alleviate some of the pressures from agriculture, such as sheep overgrazing brought about by the original CAP, but whether these will be successful in the long-term remains to be seen.

One of the most urgent requirements regarding nature conservation in Ireland is for the necessary legislation to implement the habitats and wild birds Directives to be put in place forthwith. The long overdue amendment to the Wildlife Act of 1976 also demands immediate action so that the sites designated as proposed NHAs can be given a statutory basis. The European Commission, apparently, views very seriously Ireland's delay in bringing its wildlife protection Directives into force.

Eco-tourism appears to be a trend that tourism throughout the world is taking and Ireland is well placed to benefit from this tendency in the tourist market. In the introductory remarks it was stated that Ireland's natural heritage is among its main attractions as a holiday destination and as such is an invaluable asset worthwhile protecting. Tourism, however, can bring its own pressure which makes the conservation and management of the natural environment all the more imperative. In 1994 the number of overseas visitors exceeded the native population for the first time. As an example of people pressure the case of Dún Aengus, the late Bronze Age structure on Inis Mór in the Aran Islands with up to 100,000 visitors annually, can be cited: it has suffered such a negative impact that an OPW plan to limit numbers in the future is being considered. Similar restrictions may also have to be put in place to safeguard flora and fauna from human pressure in sensitive areas. Other effects of people pressure would include hydraulic overloading of sewerage schemes, which were designed to service a particular population equivalent, with resulting pollution of rivers and streams. This has already happened

in the case of Killarney where, because of pollution effects to Lough Leane, the sewage treatment had to be upgraded and it is likely that other tourist towns will follow suit if the current trend of increase in visitor numbers continues. As an example of impact on fauna the case of the pike (*Esox lucius*), a species highly prized for eating in parts of Europe, can be cited: angling tourists were taking this species from some rivers and lakes in such numbers that measures, including the erection of signs prohibiting the killing of the fish, were implemented by the fishery authorities here recently to safeguard its populations (Chapter 9).

At the outset the natural heritage was described as the country's inheritance of the natural environment. So how is this precious legacy being preserved for future generations by the present guardians? If an assessment of Ireland's record in protecting its natural heritage over the last decade was to be made then the conclusion might read 'satisfactory but with room for improvement'.

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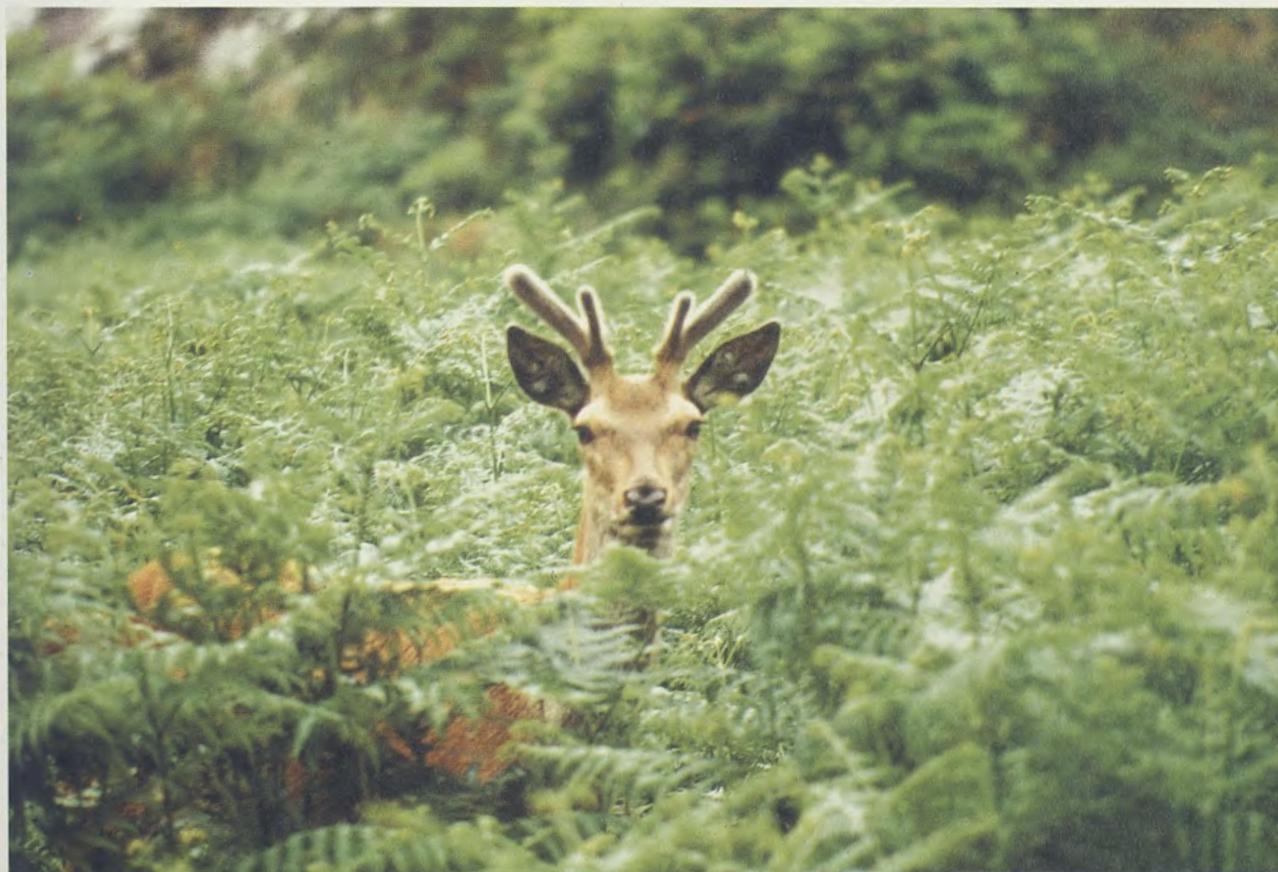
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Appendix 12.1 Habitats and Animal/Plant Species Occurring in Ireland which are Listed in Council Directive 92/43/EEC of 21 May 1992 on the Conservation of Natural Habitats and of Wild Fauna and Flora (CEC, 1992).

Habitats**Priority**

Lagoons

Fixed "grey" dunes

Decalcified fixed dunes with *Empetrum nigrum*

Eu – Atlantic decalcified fixed dunes

Machairs

Turloughs

Semi-natural dry calcareous grasslands rich in orchids

Species-rich siliceous *Nardus* grasslands in mountain areas

Active raised bogs

Active blanket bogs

Cladium fens

Petrifying springs with tufa formation

Limestone pavements

Bog Woodland

Yew Woodland

Residual alluvial forests

Non-priority

Submerged sandbanks

Estuaries

Tidal mudflats and sandflats

Reefs

Large shallow inlets and bays

Annual vegetation of coastal shingle drift lines

Perrenial vegetation of stony coastal banks

Vegetated sea cliffs

Salicornia swards

Spartina swards

Atlantic salt meadows

Mediterranean salt meadows

Embryonic shifting dunes

Marram white dunes

Dunes with creeping willow

Fauna and Flora**Mammals**

Rhinolophus hipposideros
(Lesser horseshoe bat)

Halichoerus grypus (Grey seal)

Phoco vitulina (Common seal)

Tursiops truncatus (Bottle-nosed dolphins)

Phocoena phocoena (Porpoise)

**Lutra lutra* (Otter)

Fish

Lampetra fluviatilis (River lamprey)

Lampetra planeri (Brook lamprey)

Petromyzon marinus (Sea lamprey)

Salmo salar (Salmon) - only in freshwater

Alosa spp. (Shad, including Killarney Shad)

Acipenser sturio (Sturgeon)

Crustaceans

Austropotamobius pallipes (White-clawed crayfish)

Insects

Euphydryas aurinia (Marsh fritillary)

Molluscs

**Geomalacus maculosus* (Kerry slug)

Vertigo angustior

Vertigo geyeri

Vertigo moulinsiana

} semi-aquatic snails

Margaritifera margaritifera (Freshwater pearl mussel)

Vascular Plants

Najas flexilis (Slender naiad)

Saxifraga hirculus (Marsh saxifrage)

Trichomanes speciosum (Killarney fern)

Bryophytes

Drepanocladus vernicosus (Shining sicklemoss)

Petalophyllum ralfsii (Petalwort)

contd.

Habitats (Non-priority) (contd.)

Dunes with sea-buckthorn

Humid dune slacks

Lowland oligotrophic lakes

Upland oligotrophic lakes

Hard oligo-mesotrophic lakes rich in stoneworts

Naturally eutrophic lakes

Dystrophic (peat-stained) lakes

Lowland rivers rich in water crowfoot

Pioneer river vegetation rich in annuals

Wet heaths

Dry heaths

Alpine and sub-alpine heaths

Juniper scrub

Grasslands on soils with a high heavy metal content

Semi-natural dry calcareous

grasslands other than those rich in orchids

Malinia meadows

Eutrophic tall herbs

Lowland hay meadows

Degraded raised bogs still capable of
natural regeneration

Non-active blanket bogs

Transition mires and quaking bogs

Depressions on peat substrates

Alkaline fens

Siliceous scree

Calcareous scree

Vegetation of dry calcareous rocky slopes

Vegetation of dry siliceous rocky slopes

Pioneer vegetation of rock surfaces

Caves not open to the public

Submerged or partly submerged sea caves

Old oak woods in the British Isles

* the otter and the Kerry slug are also listed as species in need of strict protection as is the natterjack toad (*Bufo calamita*); the pine marten (*Martes martes*) and the Irish hare (*Lepus timidus*), as well as some of the above fauna species, are listed as species whose taking in the wild and exploitation may be subject to management measures.

NOISE

INTRODUCTION

Sound is caused by small pressure fluctuations in the air and noise has often been defined as unwanted sound. One of the objectives of the European Union (EU) Fifth Environmental Action Programme is that no person should be exposed to noise levels which endanger health and the quality of life. Exposure to high levels of noise can have adverse effects on human health, affecting hearing, by causing problems such as loss of hearing and tinnitus (ringing in the ears), and giving rise to stress-related problems. Lower levels of noise also give rise to disturbance and annoyance.

The more significant physical characteristics of environmental noise include the following:

level - the measurements of which broadly agree with human assessment of loudness;

temporal aspects - noise is rarely steady but is likely to vary from moment to moment, from day to day, and more importantly, from day to night; it may be transient or intermittent;

characteristics - (a) whether the noise is impulsive or abrupt in nature or whether it contains clearly audible tonal components such as hisses or whines; (b) whether the frequency range (pitch, tone) is broad or narrow; and (c) whether it contains a certain amount of information content - which can add to its annoyance propensity.

The range of levels of noise to which individuals are exposed and the non-continuous nature of noise make it difficult to create one standard system for noise measurement, which different countries would be prepared to implement. The approach adopted to expressing noise levels varies depending on the type of source in question, and further details are given in the box below. Some typical sound levels deriving from particular activities are shown in Fig. 13.1.

EFFECTS OF ENVIRONMENTAL NOISE

Unlike industrial or recreational noise, environmental noise will generally not produce hearing impairment. Instead it is liable to cause annoyance and/or sleep disturbance. Annoyance is very difficult to quantify. It can be related to the loudness, pitch, frequency or number of noisy events. It does, however, impinge on the lives of those affected so as to be detrimental to their well-being.

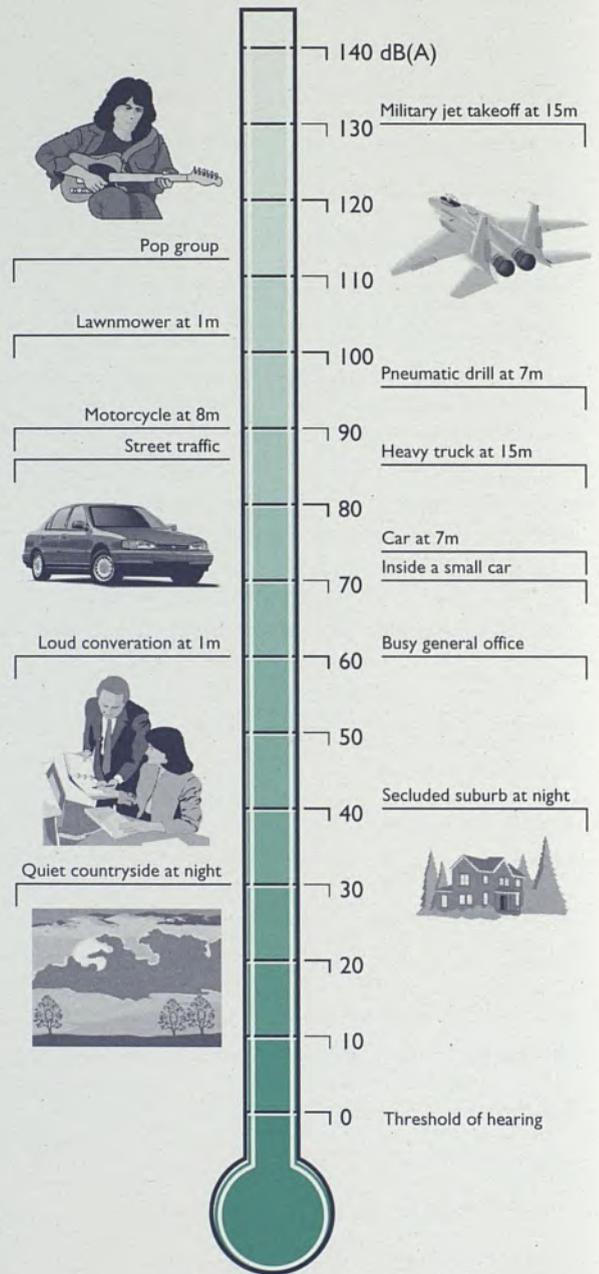


Fig. 13.1 Some Typical Sound Levels (based on Staunton, 1993).

Some Units for Measuring Noise

dB(A) Sound levels are measured in units called decibels (dB). Environmental noise levels are usually assessed in terms of A-weighted decibels, the dB(A). The A-weighting approximates to the response of the human ear. (In the present chapter the A-weighting is taken as being understood).

L₁₀ The noise level which is exceeded for 10 per cent of the measurement period.

18 hour L(10) Average of the L₁₀ values for each hour of an 18 hour period.

L_{eq} This represents the steady noise which over a given period has the same acoustic energy as the actual noise.

PNdB Jet aircraft are judged to be far noisier than propeller aircraft. This led to the development in the USA of a single number rating scheme which would reflect the actual perceived noisiness of sounds of different spectral content. The calculation scheme developed is called Perceived Noise Level (PNL) and the unit is the Perceived Noise decibel, the PNdB.

This unit was later further developed to include corrections for tone content and duration and called Effective Perceived Noise Level (EPNL). This unit is used for noise certification of aircraft as specified by the International Civil Aviation Organisation (ICAO).

NNI The Noise and Number Index (NNI), used in Ireland for aircraft noise, was developed in the UK and was used to predict people's annoyance. Research deduced that "exposure to aircraft noise" reaches an unreasonable level in the range 50-60 NNI. Values of 35, 45 and 55 NNI were used to denote low, moderate and high community annoyance.

The UK Department of Transport published interim corresponding values of NNI and L_{eq} as follows:

NNI	L _{eq}	NNI	L _{eq}
35	57	50	66
40	60	55	69
45	63	60	72

Sleep disturbance is a more measurable quantity. This is directly related to the level and the number of noise events during the night. Such noise can lengthen the time it takes to fall asleep, reduce sleep time and generally impair sleep quality. Further, habituation does not occur which implies that the quality of life of those subject to sleep disturbing noise is reduced for as long as the noise continues.

EUROPEAN INITIATIVES

At EU level, certain sources of environmental noise are at present addressed by way of Directives specifying noise standards as a condition in the granting of approval for new equipment ranging from lawnmowers to tower cranes; in-service noise standards are not generally specified.

There has been a more recent development in which, on the basis of consultations with Member States and a report commissioned from its consultants, the European Commission is preparing a Communication on a future EU Noise Policy. The Communication is expected to include proposals for the achievement of common noise standards in each Member State as well as programmes to achieve common noise reduction targets. The harmonisation of noise measurement indices is expected to be addressed so as to avoid the present proliferation of noise measurement indices throughout the EU.



Summary of European Union Noise Legislation

Council Directive 70/157/EEC
- Motor Vehicle Exhaust Systems

Council Directive 78/1015/EEC
- Motorcycles

Council Directive 79/113/EEC
- Construction Plant and Equipment

Council Directive 80/51/EEC - Subsonic Aircraft

Council Directive 84/533/EEC - Compressors

Council Directive 84/534/EEC - Tower Cranes

Council Directive 84/535/EEC - Welding Generators

Council Directive 84/536/EEC - Power Generators

Council Directive 84/537/EEC
- Hand-held Concrete-breakers and Picks

Council Directive 84/538/EEC - Lawnmowers

Council Directive 84/594/EEC - Household Appliances

Council Directive 86/662/EEC
- Excavators, Dozers, Loaders

Council Directive 89/629/EEC - Subsonic Jet Aircraft

Note: several of the foregoing Directives have been amended and 'adapted to technical progress' in subsequent Directives.

(Commission of the European Communities DGXI, 1992).

NATIONAL REGULATIONS

In 1995 the Environmental Protection Agency (EPA) published a Guidance Note on noise for the Scheduled Activities listed in the Environmental Protection Agency Act, 1992 (EPA Act). The objective of the guidelines is to minimise the amount of noise (including vibration) received by people living in or working in noise sensitive areas. These would typically include domestic dwellings, hospitals, schools, places of worship, areas of leisure or of high amenity. (As a special case, legislation and regulations relating to aircraft noise are considered later in this chapter).

Action by Individuals

In June 1994 the Minister for Environmental Protection made regulations under section 108 of the EPA Act which are designed to simplify, strengthen and streamline the procedures for dealing with noise nuisance. They provide the individual person (or the local authority) with the power and opportunity to take action where he or she feels that any noise is giving reasonable cause for annoyance. Under previous legislation it had been necessary to have complaints from three individuals in separate residences. The Regulations repeal section 51 of the Local Government (Planning & Development) Act, 1963, which previously was relied on to deal with noise nuisance.

The Regulations are specifically drafted to allow any person to make and pursue a complaint. The initial step in the process is to notify the person responsible for causing the noise of the complainant's intention to make a formal complaint to the District Court. It is a matter for the individual to decide if he or she wishes to pursue the complaint through the courts.

The next step is for the complainant to serve a Notice on the person alleged to have caused or been responsible for the noise, stating that a complaint is being made to the District Court. The Notice must be served at least seven days in advance of the complaint being made to the court. Only the courts decide on the measures, if any, to be taken and they may order the person or body, causing or responsible for the noise, to take appropriate measures to reduce, prevent or limit the noise.

Action by Authorities

Section 107 of the EPA Act gives power to local authorities or the EPA to serve a Notice requiring measures to be taken to prevent or limit noise. The Agency can serve a Notice only in relation to an activity for which a licence is required under Part IV of the EPA Act but has not yet been issued; where a licence has been issued, noise is controlled by the licence itself. A Local Authority can serve a Notice on any person in charge of any premises, processes or works, other than an activity controlled by the EPA.

A section 107 Notice must indicate the measures to be taken to prevent or limit the noise, and may specify a period within which such measures are to be taken. A person served with a Notice can make representations in writing to the appropriate authority and, having considered such representations, the authority or Agency may amend a provision in the Notice. Failure to comply with a Notice is an offence and allows the relevant authority to take steps to secure compliance.

Section 107 requires the local authority or the EPA to maintain a register of Notices issued, amended or revoked. This register is available for public inspection during office hours at EPA Headquarters.

Case Study - Local Noise Nuisance

A cabinet maker proposed opening for business within an industrial estate in a building 10 m from a dwelling. As the previous occupants of the industrial building caused environmental problems to the residents the cabinet maker was approached by the Local Authority advising him of the situation. Noise measurements were made which showed that all the machinery he proposed to use emitted pure tones and that without measures to eliminate the tones and reduce the noise level it was certain that the business could not be operated without causing a nuisance.

As the business owner intended to work both inside and outside normal working hours he sought advice on what steps could be taken to avoid the problems. A number of measures were suggested.

After the agreed time had passed, it became clear that the owner was not going to carry out the necessary works and a Notice under Section 107 of the EPA Act was served requiring reduction of the noise. No response was received to the Notice and further noise readings were taken which showed that the level was excessive, in that it exceeded the background by more than 10 dB(A), averaged over an hour, and that pure tones were clearly audible. The owner was prosecuted under the EPA Act, and the nuisance was abated.

(Source: Fingal County Council).

Example of Local Guidelines on Noise Levels

The following guidelines on noise levels were developed initially by Dublin County Council (for application only to industrial, commercial or public leisure activities, and not to domestic, transport or construction noises).

The noise level outside any residence, at the boundary of any residential zone area, any site for which residential development has at least outline approval, and hospital or any school shall:

- (i) not contain any pure tones;
- (ii) not exceed the background level by 10 dB(A) or more;

- (iii) notwithstanding (ii) above, the noise level shall not exceed 65 dB(A) by day or 45 dB(A) by night (maximum acceptable limits).

In the case of noise which will only last a short time (i.e., a few weeks) the above standards may be temporarily relaxed. In cases where it is impossible to measure the noise due, for example, to the interference of traffic noise, prediction methods should be used. The duration and frequency of noise events should be considered when assessing annoyance. A correction for impulsive character of 5 dB(A) shall be added to the measured or predicted level where appropriate.

If background levels cannot be measured on site due to the continuous presence of the noise under investigation, then measurements at another site that approximates to the conditions at the site of interest may be used.

When a background is established in relation to a particular reception point, all future noise sources affecting this point shall be assessed with respect to the originally established background. It shall not be necessary to attain a standard below 45 dB(A) by day or 35 dB(A) by night where very low backgrounds exist.

Where specific guidelines have been drafted for assessing specific types of events they should be used instead of these proposals.

GENERAL SOURCES OF ENVIRONMENTAL NOISE

A major source of environmental noise is transport, with road traffic and aircraft being by far the most usual causes of noise disturbances to the city and suburban resident. Other sources of noise include various types of industrial and commercial activities, construction sites and general neighbourhood noise. Fixed and identifiable sources such as these tend to give rise to the majority of complaints of noise nuisance (see below). Occupational noise within the workplace does not fall within the scope of this report.

Causes of noise-related complaints received by Dublin Corporation in the period 1981-1990 were listed as part of Irish Environmental Statistics by the Environmental Research Unit (1993). The total numbers of complaints of different types are given in Table 13.1.

Table 13.1 Causes of Noise-related Complaints Received by Dublin Corporation Covering the Period from 1981 to 1990 (excluding 1983-1984).

Causes of Complaint	
Industrial	90
Ventilation systems	34
Traffic	34
Factory noises	33
Garage/Workshop	31
Factory fan	26
Construction/Building sites	26
Licensed premises	24
Residential/Domestic	21
Band Practice	19
Bakeries	18
Discotheques/Night clubs	15
Compressors	15
Tannoy	14
Shop/Shop fronts (Broadcasting)	13
Record shops	10
Recharging of refrigerated vans	9
Boiler house incinerators	7
Alarms, sirens	6
Domestic oil-fired central heating	5
Broadcasting	4
Chainsaw/Circular saw	4
Laundries	4
Shopping centre incinerators	3
Restaurants	3
Trucks	3
Central heating installation	2
Factory generator	1

The levels and the types of noise which give rise to nuisance vary for different localities. Clearly what may be considered to be a nuisance in a busy city centre will be very different from what is considered a nuisance in a suburban or a rural area.

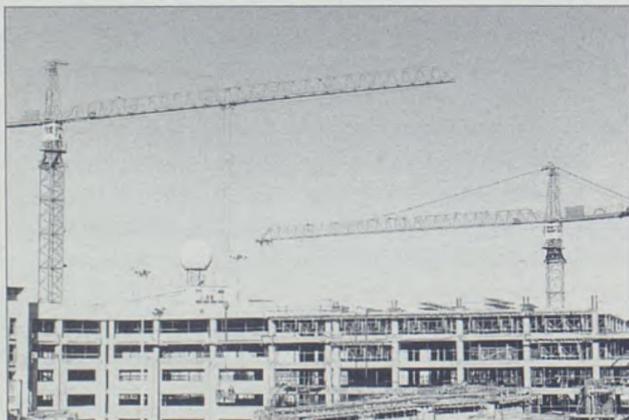


Table 13.2 Complaint Types where Monitoring was Carried Out in Dublin City Since July 1994.

Type of Complaint	No. of Complaints
Extract fans/Refrigeration units	16
Pubs/Discos	10
Neighbours	7
Music/Drum practice	5
Industrial	5
Construction	5
Vehicles/Traffic	3
Small/private workshops	3
Miscellaneous	3
Concerts	2
External speakers on shop fronts	1

In Dublin City, during the nine month period since the Noise Regulations were introduced in July 1994, monitoring was carried out in over 60 cases. The types and sources of the complaints are listed in Table 13.2.

It can be seen from Tables 13.1 and 13.2 that there is a preponderance of complaints in relation to specific sources of noise. Industrial/factory noises feature strongly, particularly in the earlier period (Table 13.1), and extraction fans and ventilation systems represent another frequent cause of complaint. The position of traffic on the list may not be a true reflection of its significance as a source of noise nuisance, because complaints are more likely to be made about fixed and readily identifiable individual sources.

During the period represented in Table 13.2, a total of 21 notices were served by the Local Authority under Section 107 of the EPA Act. Of these, 18 were complied with and one was partially complied with; legal proceedings were initiated in one case and prosecution for non-compliance was recommended in another.

Fans, extraction units and factory machinery also feature largely in the causes of complaints to Limerick Corporation, and constituted about half of all of the complaints in the period 1990-1994. Two cases of noise nuisance from commercial/factory premises in the period led to civil action being taken, with damages being awarded in one case and time allowed for undertaking noise reduction measures in the other.

In Limerick also, as part of an investigation into the proposed short term extension to a landfill site, the likely effect of noise on the environment during normal on-site activities was assessed. It was concluded that noise emissions from activities related to the proposed landfill extension site would not have a significant effect on the existing noise environment in the surrounding area.

Outside cities other causes of complaint may arise. Complaints to Fingal County Council in a recent period included three related to vibration (blasting) and eight related to bird scarers.

Case Study - Industrial Compressor

A complaint was received regarding noise from a factory caused by "something switching on and off during the night". Noise measurements revealed that the noise level at the complainant's house rose sharply for about fifteen minutes in every half-hour during the night but was less noticeable during the day when the background level masked the noise.

The background level at night was approximately 36 dB(A) and the offending noise was 54 dB(A). Under these circumstances a maximum level of 45 dB(A) was deemed desirable.

The company in question were contacted by the Local Authority and agreed to take the necessary steps to reduce the noise from what was identified as a compressor. Further noise readings were then taken when the work was done and the levels were shown to have reduced to below 45 dB(A). The complainants were satisfied with the result and no further action was taken.

(Source: Fingal County Council).

Industrial estates bordering on residential areas can give rise to particular problems, and this issue is clearly linked to overall questions of physical planning, the need for buffer zones and the need to ensure that activities giving rise to noise at night are not located near the perimeters of industrial estates.

ROAD TRAFFIC NOISE

Road traffic is a source of noise that disturbs many people. In measuring road traffic noise the microphone is placed at the most exposed facade of a building. In most countries road traffic noise is expressed using the L_{eq} index, but there is a lack of uniformity as to the relevant time period of the measurement. Mostly the daytime L_{eq} is used, the levels of which encountered in urban areas usually lie between 55 and 77 dB.

Regulations and guidelines vary between countries. The example of France is fairly typical where the objective for new roads is that the daytime L_{eq} should if possible not exceed 65 dB. In certain circumstances, a level as low as 60

dB is sought, whereas in others, at the high end, 65 dB may be exceeded but without passing 70 dB.

For comparison it may be noted that industrial noise is also usually expressed in L_{eq} . The criterion for industrial noise outside residential premises during the day is usually a L_{eq} of 50 or 55 dB. Level for level, traffic noise is less objectionable (or objected to) than industrial noise (and railway noise less again).

The index used in the UK is the 18 hour $L(10)$. The limit for the 18 hour $L(10)$ in UK legislation is 68 dB(A) for new roads before abatement at the point of reception is required. Since the daytime L_{eq} value is approximately 2 dB less than the 18 hour $L(10)$, this value of 68 is approximately equivalent to a daytime L_{eq} of 66.

Impact of Road Developments Dunleer-Dundalk Motorway

The construction of by-pass roads and motorways can have a significant net benefit in terms of the number of persons exposed to traffic noise. This is illustrated by a study relating to the Dunleer-Dundalk Motorway.

Noise levels, expressed as dB(A) 12 hour L_{eq} , were measured on the line of the proposed road. A level of 49 dB was recorded near a quiet country road and is typical of the noise level expected in rural areas relatively unaffected by road traffic noise. Levels of between 58 and 68 dB recorded at locations near busy roads are typical of those expected at dwellings located in these conditions.

(One of the sites measured gave an indication of the sound levels experienced at properties in the vicinity of the Dublin - Belfast railway line. The average four hour reading at 33 m from the train track was 64 dB. The L_{eq} measured during the instant of actual train passes was 85 dB).

Noise was predicted using a computer package (SOUNDTRACK) which gives results in line with accepted practice abroad.

Eighty-eight dwellings were within 100 m of the proposed new roads, or roads on which traffic would increase because of the scheme. One thousand three hundred dwellings were on roads where traffic and noise would decrease because of the scheme. It was concluded that an estimated 49 dwellings would experience an increase of 6 dB or more at some window. There would be a reduction of 6 dB or more at 309 dwellings.

(Staunton, 1993).

In Ireland, both the 18 hour L(10) and daytime L_{eq} are used. While much work has been done on noise measurements using the former, in order to help simplify the presentation of information in this chapter, noise levels wherever possible are expressed as L_{eq} . Clearly a more unified approach to noise measurement is desirable and all relevant factors would need to be taken into account in arriving at such an approach.

Since the early 1970s noise emission limits in EU countries have been significantly reduced. The policy of approval for road transport vehicles ensures that new vehicles, at the time of manufacture, are in compliance with the specified noise limits. Manufacturers have responded by reducing mechanical noise and it is thought that a point may soon be reached where tyre noise could restrict any further lowering of limits in the future. The EU emission limits for selected vehicle categories are shown in Table 13.3.

Table 13.3 EU Noise Emission Limits for Selected Vehicle Categories (values expressed as dB(A)).

Vehicle Category	1972	1982	1988/90	1995/96
Passenger Car	82	80	77	74
Urban Bus	89	82	80	78
Heavy Truck	91	88	84	80

Noise levels due to traffic are influenced by factors such as the distance of the property from the road, the physical layout of the site, the number of vehicles, traffic composition and speed. Fig. 13.2 shows hourly values for L_{eq} levels on a heavily trafficked primary route and also for a rural area with a distant primary route. Table 13.4 gives daytime L_{eq} measurements over one hour at locations within Dublin. Table 13.5 shows daytime L_{eq} measured over one hour at a random selection of dwellings outside Dublin.

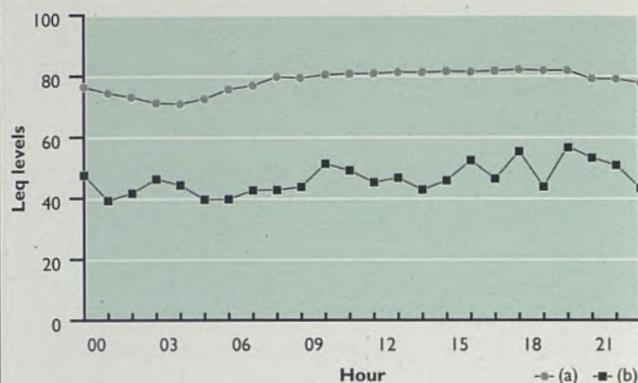


Fig. 13.2 Hourly Values for L_{eq} levels (a) on a busy primary route and (b) for a rural area with a distant primary route (Source: Forbairt).

Table 13.4 Road Traffic Noise Levels Measured in Dublin*.

Residential Zones	L_{eq}
Landscape Gdns., Churchtown	49
Argyle Road, Donnybrook	57
St. Peter's Road, Phibsboro	55
Grange Road, Baldoye	47
Mulroy Road, Cabra	54
Park Avenue, Sandymount	62
South Hill Road, Dartry	49
Dunseverick Road, Clontarf	53
Sion Hill Road, Kimmage	52
Clonmacnoise Road, Crumlin	62
Church Avenue, Glasnevin,	54
Rathvale Grove, Coolock	61
Recreational Zones	
Phoenix Park (main road)	65
St. Stephen's Green (boundary)	70
Herbert Park (boundary)	64
Hospital Zones (inner city)	
Rotunda	65
Coombe	68
Mater	70
Baggot Street	70
Holles Street	69
Hospital Zones (suburbs)	
Bon Secours, Glasnevin	67
Crumlin Children's	61
Cherry Orchard	70
St. Vincent's	61
Beaumont	49
Clonskeagh	74

Residences on Main Roads

Upper Drumcondra Road	76
Howth Road	69
Navan Road	76
Tyrconnell Road	81
Upper Rathmines Road	70
Crumlin Road	76
Swords Road	77
Clontarf Road	64

Busy Streets and Roads

Aston Quay	73
Dame Street	75
Westmoreland Street (Ballast House)	74
Ormond Quay	76

* Daytime L_{eq} measured over 1 hour; calculated from data measured in working hours, Tuesday to Thursday, 1985-1986.

Table 13.5 Road Traffic Noise Measured at a Random Selection of Residences Outside Dublin.

Isolated House	L_{eq}
Ballinacarrick Lough, Co. Mayo	30
Quiet Country Road	
Near Westport, Co. Mayo	41
Blackbog Bridge, Co. Louth	49
Busy Country Road	
Carnanbregagh, Co. Louth	60
Residential Road	
Frederick Avenue, Carlow	50
Glanmire, Co. Cork	51
Upper Curragh Road, Castlebar	57
Quiet Suburban Road	
Doughiska, Galway	53
R417, Athy Road, Carlow	54
Busy Suburban Road	
R339, Ballybrit, Galway	56
N2, Ardee, Co. Louth (a)	58
N2, Ardee, Co. Louth (b)	62
Pavilion Road, Castlebar	63
N1, Redcow, N. Dundalk	65
N1, Carroll's Jn., S. Dundalk	66
N52, Ardee, Co. Louth	66
N60, Station Road, Castlebar	68

Town Centre

Academy Street, Navan	64
Ludlow Street, Navan	67
Main Street, Midleton, Co. Cork	70
Main Street, Dundalk	71
Park Street, Dundalk	73

Daytime L_{eq} measured over 1 hour during working hours, Monday to Friday, 1988-1995. Measurement points (a) and (b) are on different properties.

(Source: National Roads Authority).

Developments

As engine noise has been successfully reduced, a significant proportion of noise from road traffic is now produced by tyres. Tyre noise can be influenced by the type of tyre in use and the nature of the road surface. It has been shown that traffic on a porous asphalt surface is up to 4 dB quieter under dry conditions than traffic on a conventional asphalt surface. However, the use of porous asphalt on roads in Ireland could be problematic as the pores may fill up. The construction of earth banks or barriers made of concrete, metal, plastics, timber or other materials can reduce the level of noise from roads.

Thus, in the future there may be a higher priority on laying quieter road surfaces. At present in the UK it is recommended that, both in new road construction and resurfacing, porous asphalt or whisper concrete should be used at all appropriate sites (Royal Commission on Environmental Pollution, 1994). The maintenance needs of such surfaces are a factor in decisions on their use.

By-pass roads and motorways can give rise to a significant net reduction in the numbers of persons exposed to noise. For this to be maintained, strict planning controls are required in the areas of the new roads.

RAILWAY NOISE

The noise from railways which mostly affects people living near them is caused by passing trains, shunting, engineering work in depots and on tracks, and by safety devices such as horns. There is no evidence of widespread public annoyance arising from railway noise because most people living or working near railways have become accustomed to railway noise and are virtually insensitive to it. Railway noise has become less of a problem with technological advances and the modernisation of the railways. The following items help to reduce the level of noise emitted by trains operated by Iarnród Éireann:

- electric suburban trains;
- small diesel engines on new railcars;
- better engine silencers on new diesel engines;
- change from wheel tread brakes to disc brakes;
- increased use of electric brakes;
- continuous welded rail;
- lubrication of wheel flanges and track curves;
- grinding of rail corrugations.

Also, new gantries and new forklift trucks operating in freight yards are sound-proofed to reduce operating noise.

Iarnrod Eireann has stated that it intends to continue to reduce noise levels where possible by ensuring adequate sound-proofing of new equipment and "sensitive" operations wherever possible.

AIRCRAFT NOISE

The sound power output of an individual aircraft is orders of magnitude greater than any other transportation source. The most obvious cause of aircraft noise is the engine exhaust, but fan noise from the intake as well as aerodynamic noise are also factors. The unobstructed transmission path may lead to disturbance over a relatively large area which may include residential areas. The extent of nuisance caused depends on the level of noise, distance from the source, the number of operations and the time of day. Social surveys have been carried out in other countries to try to quantify the extent of noise nuisance.

Legislation requires that aircraft have a Noise Certificate issued by the Irish authorities (or another national authority with equivalent standards). Standards and recommended practices (SARPs) for aircraft noise have been issued by the International Civil Aviation Organisation (ICAO). The EU has issued Directives with particular reference to noise prevention. The European Civil Aviation Conference (ECAC) has also issued recommendations. The European Joint Aviation Authorities (JAA) are in the process of issuing Requirements to their national authorities. Ireland has adopted the ICAO, EU and ECAC standards and incorporated them into Statutory Instruments since the early 1970s (see box).

Legislation Covering Aircraft Noise

Body	Legislation on Noise	(Year)
ICAO	Annex 16 (and amendments)	(1971-1995)
EU	Directive 80/51/EEC Noise Certification	(1980)
EU	Directive 83/206/EEC	(1983)
EU	Directive 89/629/EEC Bans registration of Chapter 2* aircraft	(1989)
EU	Directive 92/14/EEC Withdrawal of Chapter 2* aircraft from operations by 2002	(1992)
ECAC	Recommendation ECAC/9-19	(1976)
ECAC	Recommendation ECAC/13-2 Non addition of Chapter 2* aircraft to national registers	(1988)
ECAC	Recommendation ECAC/14-2 Chapter 2* Operating Restrictions	(1991&1992)
IRELAND		
	Air Navigation (Noise Certification and Limitation) Order S.I. No. 250 of 1976	(1976)
	Air Navigation (Noise Certification and Limitation) Orders S.I. No. 13 of 1984	(1984)
	European Communities Regulations. S.I. No. 235 of 1990	(1990)
	European Communities Regulations. S.I. No. 130 of 1993.	(1993)

* refers to Chapter 2 of ICAO Annex 16 (see text)

The legislation requires the progressive elimination of older 'Chapter 2' aircraft as EU countries are no longer allowed to register aircraft from outside the Union that do not conform to the engine noise standards (ICAO Annex 16 'Chapter 3'). This will result in all aircraft using Irish and European airports meeting the more stringent standards by the year 2002.

The environmental impact of the operation of aircraft is continuously assessed by the regulatory authorities, airport authorities and airlines. Development planning within the vicinity of the major airports is monitored to minimise the effect of aircraft noise on the urban and rural environment. Much strategic planning is required to balance the future needs of the community and the airports. The planning of training areas for light aircraft also takes into account areas outside the immediate vicinity of airports with legislation prohibiting the operation of aircraft below 152 m over open spaces and 457 m over built up areas, with the exception of take-off and landing.

A universally acceptable method for continuous and reliable measurement of aircraft noise has not yet been achieved. Various noise scales and techniques have been developed for rating single aircraft events, and composite indices have been produced which attempt to correlate with disturbance to communities. The complexity of the problem has led to numerous scales and indices, different correlations with human disturbance, and differing judgements on the effects and methods of amelioration of the disturbance (see box on page 185).

The World Health Organisation (WHO) suggests that general daytime outdoor noise levels equivalent to less than 57 L_{eq} (16 hour) dB(A) for aircraft noise are desirable to prevent any significant community annoyance.

In relation to the Noise and Number Index (NNI), without adequate sound insulation, persons in areas subject to between 40 NNI and 50 NNI could find the level of aircraft noise intrusive; persons in areas subject to between 50 NNI and 60 NNI could find the level annoying and in those areas with greater than 60 NNI could find the level very annoying. Noise levels can be measured, but the effect on people in the vicinity of airports is a more subjective matter and difficult to assess as people's sensitivity to noise varies.

Developments

At Dublin Airport the number of aircraft movements increased substantially in the early 1980s, then decreased during the early 1990s and just recently has begun to increase again (Fig. 13.3). Passenger numbers in the same period have increased substantially. This has occurred, despite the decreasing movements, owing to larger aircraft and higher load factors.

Reductions in noise exposure have occurred as a result of three principal factors. One factor is the progressive elimination of the older technology aircraft with noisy engines. A second is the introduction of standard arrival and departure procedures, noise abatement procedures and routes to minimise noise impact. This involves aircraft

approaching airports using the minimum amount of power consistent with safe operation. On departure, aircrew are obliged to use the power available to gain excess height and maintain minimum climb speeds and use the minimum power consistent with safe aircraft operation. A third factor is the construction of a new main runway at Dublin Airport which altered the orientation of take-off and landing to an east-west direction thus avoiding areas of high population density and minimising the noise impact.

These factors have resulted in a significant decline of noise levels in the area and number of people affected by aircraft noise in Dublin, as evidenced by the decreasing size of the area taken up by the 35 NNI contour which is shown in Fig. 13.4. At Cork and Shannon Airports the change to quieter types of aircraft, together with active management schedules, coupled with reduced airline training, have contributed significantly to a reduction in overall noise exposures.

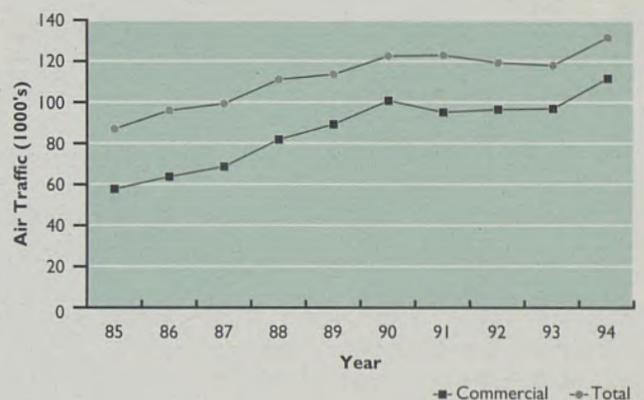


Fig. 13.3 Dublin Airport Aircraft Movements 1985-1994 (Source: Irish Aviation Authority).

It is expected that passenger numbers will continue to increase and aircraft movements will also increase, but at a low rate. The EU policy on Sustainable Mobility highlights the overall aim of the Air Transport Industry which is to ensure a policy of sustainable growth in air traffic which will minimise noise impact and effects on the environment.

It is anticipated that this will be achieved in three ways:

- compatible land use planning in the vicinity of airports;
- further improvements in aircraft technology with new larger and quieter aircraft;
- improvements in operating procedures.

It is anticipated that these measures will lead to a substantial decrease in the area contained within the 35 NNI contour in the future.



Fig. 13.4 Noise Contours at Dublin Airport Area (from data supplied by Irish Aviation Authority).

NOISE CONTOURS AT DUBLIN AIRPORT
35NNI Contour (1973) 
35NNI Contour (2000) 

VIBRATION

The EPA Act defines noise to include vibration, and ground vibration may be radiated from many sources. Some of these sources can cause disturbance and annoyance to the local community and also damage to structures. There is little evidence to suggest that ground vibration is a widespread or severe problem.

The parameter most commonly used to assess the ground vibration is the peak particle velocity expressed in millimetres per second (mm/s). As in the case of noise, the frequency of vibration is also an important consideration. According as the distance from a source increases, the level and principal frequency would be expected to decrease.

Standards relating to vibration have been promulgated by national and international organisations and there is apparent consensus on the subject of human response. Building damage is more difficult to predict, and vibration standards in this field may be specified in a probabilistic manner (Kenny, 1983).

For well maintained residential type structures there appears to be almost a consensus on a limit level below which damage is not expected. An overview of the data would suggest a conservative limit of 12 mm/s peak particle ground velocity for normal quarry type blasts. For mining, where there may be a number of blasts per day, the limit is usually less. For construction and continuous processes the limits are lower still. Where vibration is due to construction blasting or tunnel blasting at relatively short distances, the structural effect is usually less due to the higher frequencies involved, and higher limits may be appropriate.

Ground vibration problems associated with road and rail traffic are a rare occurrence and are generally due to defective bearing surfaces. For heavy commercial vehicles, the low frequency noise from diesel engines may induce vibration into lightweight structural elements, for example window glass, and give the impression of ground-borne vibration.

INFORMATION GAPS

Noise as an environmental nuisance is for the most part of a localised and often a transitory nature. Systematic gathering of noise measurements is time-consuming and expensive. Measurements are more usually made in the investigation of particular complaints. In the absence of such a systematic programme, however, it is difficult to provide an overall national picture of nuisance environmental noise levels and trends based on actual measurements.

Using a consistent methodology, occasional monitoring at a minimum number of selected sites is desirable in order to obtain improved information; such sites should include as many as possible of those measured in the past (e.g., those listed in Table 13.4) in order to help establish trends in relation to noise nuisance. There is also a need for a central reporting system.

Records of complaints concerning environmental noise provide an important indicator of the problems as perceived by the public and compilation of the national totals of such complaints and the identified noise sources would be particularly useful. Similarly, compilation of national statistics based on questionnaire surveys would be very useful in helping to determine the extent to which noise is perceived as being an environmental problem in Ireland. Such statistics could be gathered centrally at the same time as other social statistics.

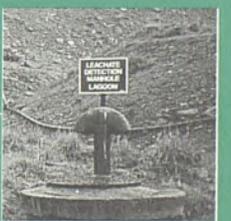
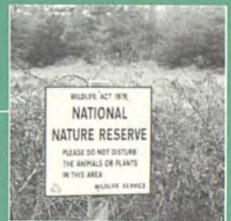
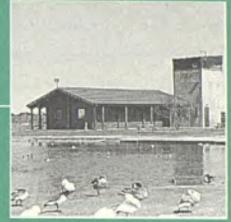
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PART **IV**

**MANAGEMENT, CONTROL
AND ECONOMIC ASPECTS**



ENVIRONMENTAL PROTECTION

INTRODUCTION

All human activities have an impact on the environment. Some of the tools used to assess the quality of the environment were introduced in Chapter 3. These tools, in particular, environmental quality objectives and standards, can be used to establish the boundaries within which economic and social development can take place without causing undue stress to the environment. Having set environmental quality objectives and standards for different environmental media, environmental protection and pollution prevention and control strategies need to be implemented. This requires, among other things, that emissions into each regulated medium be either prevented or strictly controlled.

Until recently in Ireland emissions into each medium were regulated separately. This single-medium approach can give rise to significant inputs to the least regulated medium, generally land or ocean. In addition, inter-media transfer of pollutants, such as air to water, land to water and water/land to air were not fully considered in the past. It is now recognised that an integrated approach to pollution prevention and control is required to ensure adequate protection of the environment. This means that emissions to all environmental media need to be accounted for together when the environmental impact of any activity is being considered and when an operating licence is being issued.

The most significant developments in this regard in Ireland this decade have been the establishment of the Environmental Protection Agency (EPA) and the introduction of integrated pollution control (IPC) for the licensing and regulation of the larger industrial and intensive agricultural activities that have a significant polluting potential. Under IPC, a single licence is issued by the EPA covering all potential emissions from the licensed activity to the environment. The primary emphasis is on minimising emissions to all environmental media by preventing their generation in the process, i.e., pollution prevention. Where process wastes are unavoidable, the best available technology not entailing excessive costs (BATNEEC) must be used to ensure that emissions are reduced to as low a level as is practicable, taking account of the sensitivity of the environment into which an emission is being discharged.

In this chapter the various policy and legislative instruments are outlined. Current environmental protection policy instruments at the different levels are illustrated in Fig. 14.1. These provide a framework for the development and implementation of practical strategies and tools for environmental protection, conservation and pollution prevention/control. Following this, the major strategies and tools are presented and discussed.

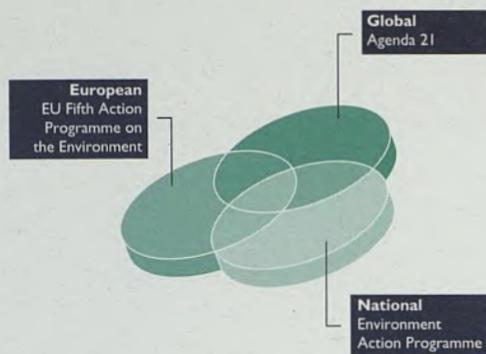


Fig. 14.1 Major Policy Instruments at Global, European and National levels.

EU Fifth Action Programme on the Environment

The Fifth Action Programme on the Environment 1993-1997, *Towards Sustainability* takes a much longer term view of development and the environment than has previously been adopted. Five sectors: manufacturing industry, energy, transport, agriculture and tourism, are selected for special attention in the Programme.

An objective of the Programme is to initiate a process which will make these vital sectors sustainable. The environmental quality and assessment themes of the Programme, which are applied to each sector, are as follows:

- climate change;
- acidification and air quality;
- protection of nature and biodiversity;
- management of water resources;
- the urban environment;
- coastal zones;
- waste management.

For each theme long term, mainly qualitative, objectives and targets are given as an indication of the sense of direction or thrust to be applied in the pursuit of sustainable development (CEC, 1992).

A report by the European Environment Agency (Wieringa, 1995) has reviewed the extent to which the measures taken to date will lead to the achievement of the target of the Fifth Action Programme on the Environment. The main findings are summarised in Chapter 17.

Agenda 21

Agenda 21 is the blueprint for global sustainable development signed by all participating nations at the United Nations Conference on Environment and Development at Rio de Janeiro in 1992.

In Agenda 21, it is explained that population, consumption and technology are the primary driving forces of environmental change. A strategy for reducing wasteful and inefficient consumption patterns in some parts of the world, while encouraging increased but sustainable development in others, is laid out. It is recognised that the richest 20 per cent of the world's nations control over 80 per cent of the world's wealth and resources and that a global partnership is required to reconcile the twin requirements of a high quality environment and a healthy economy for all the peoples of the world. Policies and programmes to achieve a sustainable balance between consumption, population and the life-supporting capacity of the Earth are put forward.

Options are provided for combating degradation of the land, air and water, and for conserving forests and the biodiversity of ecosystems. Better ways of managing fundamental natural resources such as oceans, fresh-water, air and soil are proposed, together with better ways of preventing the contamination of those resources.

Agenda 21 deals with poverty and excessive consumption, health and education, cities and farms. It is recognised that all sectors need to be involved in the exercise of planning and taking responsibility for the common future. Mechanisms for how this can happen are proposed. The importance of local involvement is recognised and local authorities are encouraged to develop Local Agenda 21 for their own districts through broad consultation with all stakeholders in the community. Other sectors that are encouraged to plan within the framework of Agenda 21 include trade unions, business and industry organisations, non-Governmental organisations and farming organisations.

POLICY INSTRUMENTS

Global and European

The principal European Union (EU) policy instruments for environmental protection, pollution prevention and pollution control are the various action programmes on the environment instituted over the past two decades. The most recent of these, the Fifth Action Programme on the

Environment 1993-1997, *Towards Sustainability*, sets the policy framework for the foreseeable future by committing the EU to a sustainable development strategy (see box).

Global policy in relation to the environment in the past twenty years has largely been driven by the various international agreements and work programmes arising out of the work of the United Nations Environment Programme (UNEP) which was established in 1972, following the first UN Conference on the Human Environment in Stockholm. The most important recent achievement of the UN on environmental matters was the United Nations Conference on Environment and Development (UNCED) held at Rio de Janeiro in 1992. All participating nations became signatories to Agenda 21, the blueprint for global sustainable development (see box). Conventions on climate change and biodiversity were adopted and agreement was reached on the Rio Declaration (the Earth Charter) which outlines a set of principles linking future social and economic progress to global environmental protection.

International policy on environmental issues is also developed by the Organisation for Economic Co-operation and Development (OECD) of which Ireland is a member.

National

National Environment Action Programme

The national Environment Action Programme (EAP) was published by the Government in 1990. This was the first comprehensive environment programme adopted in Ireland and is in line with the international trend towards a programmed strategic approach to national environmental management. The EAP sets out objectives for protecting and improving the environment across the range of public service activities and explicitly takes account of:

- the concept of sustainable development;
- the principle of precautionary action in relation to environmental risk;
- the integration of environmental considerations in all policy areas.

The EAP provides a national framework for implementing pollution prevention and environmental protection strategies in Ireland. The methodology of the EAP is based on the identification and setting of targets and policy objectives. These are then subjected to periodic review by means of progress reports, the first of which was published in 1991. Targets involving an overall expenditure of some £1 billion, over ten years, are identified in the plan and relate to a variety of measures, including proposals for improved pollution control, preservation of the natural and built environment and enhancement of amenities. Special programmes have been devised for the agriculture, forestry, energy and industry sectors and special attention paid to

waste reduction and the promotion of increased recycling (Department of the Environment, 1992).

Operational Programme for Environmental Services: 1994/1999

The Operational Programme for Environmental Services 1994/1999 (Department of the Environment, 1994a) sets out how Community Support Framework (CSF) funds are intended to be allocated over the allotted time period. It incorporates many of the recommendations made by the GREEN 2000 Advisory Group (see Chapter 1). The Programme covers direct expenditure on environmental services in Ireland and recognises that economic expansion must be supported by a modern, efficient environmental infrastructure and that maintaining a high quality environment is itself a guarantee of increased economic activity in a number of sectors. The Programme is designed to build up the environmental infrastructure of the economy for the long-term, protect natural resources and support the Government's Environment Action Programme. The proposed investment levels in the Programme are summarised in Chapter 15.

National Sustainable Development Strategy

The Government is developing a national Sustainable Development Strategy for Ireland. The Strategy will be prepared for publication by mid 1996.

The Department of the Environment (DoE) recently published a document entitled *Moving Towards Sustainability* (Department of the Environment, 1995a) which discusses recent environmental advances within the framework of a developing national sustainable development strategy (Chapter 16). The DoE also published guidelines for local authorities regarding the development of Local Agenda 21 (Department of the Environment, 1995b) (see box).

Local Agenda 21

As part of the commitment to the Earth Charter signed at the United Nations Conference on Environment and Development (UNCED) at Rio de Janeiro in 1992, each local authority in Ireland is expected to initiate a process which will result in the development of a Local Agenda 21 for its area. A Local Agenda 21 is a blueprint for sustainable development at a local level, built through consultation with and in agreement with the local community. For sustainable development to become a reality it must be built from the bottom up with the agreement of all interested parties. The development of Local Agenda 21 throughout the country is a vital part of the process of constructing a sustainable economy which respects environmental

integrity. Local Authorities have an important leadership role to play in this regard.

The first major Local Agenda 21 initiative in Ireland was taken by Dublin Corporation which organised a conference in June, 1995. Groups from other jurisdictions in which Local Agenda 21 is at a more developed stage than in Ireland were invited so that the Irish process could learn from experiences in other countries.

National Recycling Strategy

A national recycling strategy *Recycling for Ireland* was published in 1994 (Department of the Environment, 1994b). In this publication, the Government adopted a general objective of diverting 20 per cent of combined household and commercial waste away from landfill, through recycling, by 1999. In particular, packaging materials have been targeted for increased levels of recycling. The target is to increase the overall rate of recycling of packaging materials (paper, glass, plastics, metals, ferrous metal and aluminium) from 1994 levels of 10.3 per cent up to 33 per cent by 1999. This is an ambitious programme and will require the support and co-operation of all sections of society for these targets to be met. The framework for an expanded and improved infrastructure for recycling in Ireland is introduced in *Recycling for Ireland* and developed in the Waste Management Bill (see Chapter 7).

LEGISLATIVE INSTRUMENTS

International Conventions

Ireland is subject to a number of international conventions which deal with environmental protection. A number of Conventions are listed in the box below.

Some International Conventions

- International Convention on Transboundary Environmental Impact Assessment;
- International Convention for the Protection of the Ozone Layer;
- International Convention on Long-Range Transboundary Air Pollution;
- International Convention on Climate Change;
- Rio de Janeiro Convention on Biodiversity;
- Ramsar Convention on Wetlands of International Importance;
- Oslo Convention for the Prevention of Marine Pollution by Dumping from Ships and Aircraft, the Paris Convention for the Prevention of Marine

Pollution from Land-Based Sources, and the subsequent 'OSPAR Convention';

- Washington Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES);
- Bern Convention on the Conservation of European Wildlife and Natural Habitats;
- Bonn Convention on the Conservation of Migratory Species of Wild Animals;
- International Tropical Timber Agreement;
- Paris Convention for the Establishment of the European and Mediterranean Plant Protection Organisation;
- Rome Convention on International Plant Protection;
- Paris Convention on International Plant Protection;
- International Convention for the Regulation of Whaling.

European Legislation

The development of environmental law in Ireland has been greatly influenced by European legislation. The Council and Commission of the EU have issued a substantial number of environmental Directives, Decisions, Recommendations, Opinions and Resolutions since Ireland became a Member State (see Fig. 14.2). Many of the Directives issued have been transposed into Irish law through national Regulations and cover matters relating to air and water quality, noise, waste, accidents and environmental impact assessment (EIA). Various Directives are dealt with in preceding chapters of this report.

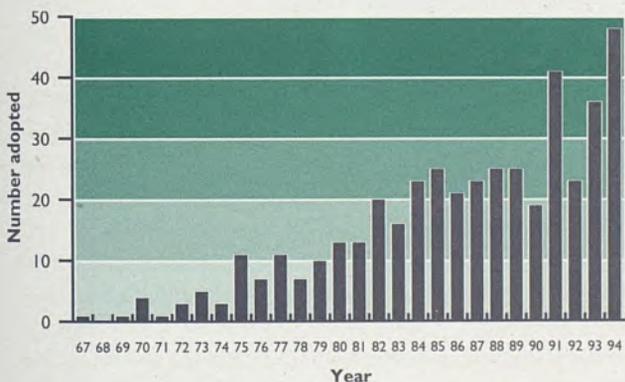


Fig. 14.2 EU Environmental Legislation Adopted Each Year (Haigh, 1992-1994).

National Legislation

Modern environmental legislation in Ireland can be traced back in particular to the enactment of the Local Government (Planning and Development) Act, 1963, and the Local Government (Water Pollution) Act, 1977. Generally, modern domestic environmental legislation can be considered in three parts as follows:

- Acts and Regulations dealing with the planning process before a facility has been constructed or a regulated activity commenced;
- Acts and Regulations dealing with the licensing and control of a facility/activity when in operation;
- Acts and Regulations dealing with general environmental conservation matters.

Each of these is outlined below.

Planning and Environmental Impact Assessment

The Local Government (Planning and Development) Act, 1963, established a comprehensive authorisation procedure for new development which included a requirement to consider environmental matters relating to a development. The Environmental Protection Agency (EPA) Act, 1992, has marked a major change, whereby the Agency (rather than planning authorities and An Bord Pleanala) becomes responsible for environmental pollution matters in relation to activities that are licensable by the Agency.

The requirement for conducting comprehensive EIAs as part of the planning application process was first introduced to Ireland in 1988 (S.I. No. 221 of 1988) in compliance with the 1985 Directive on Environmental Impact Assessment (85/337/EEC). The Local Government (Planning and Development) Regulations, 1990 and 1994, set out in detail the procedures required for conducting EIA in Ireland.

The principal rationale behind EIA is the identification of the likely and significant effects of any project on the environment. In Directive 85/337/EEC, project types are listed in two Annexes. For projects listed in Annex I, which include major developments such as motorways, hazardous waste disposal installations, crude oil refineries, power stations, construction of airports and ports and installations for the extraction and processing of asbestos, an EIA is mandatory. Member States have discretion as to whether or not projects listed in Annex II require an EIA and can identify criteria and/or thresholds for each project type to determine whether or not an EIA is required.

In Ireland, under national regulations, an EIA is required for several project types listed in Annex II, regardless of their size or location, such as, mining and petroleum extraction, chemical and pharmaceutical production and fish meal and fish oil plants. Thresholds have been set for the remaining project types listed in Annex II.

Legislation governing EIA is continuing to evolve. The Local Government (Planning and Development) Act, 1993, as a general rule, now requires all State Authorities to obtain planning permission for their developments in the same manner as a private sector developer. EIA, when used wisely, is an important tool for assisting the sustainable development of the economy.

Pollution Prevention/Control and Environmental Protection

The principal domestic Acts governing the prevention and control of pollution in Ireland are the Local Government (Water Pollution) Acts, 1977 and 1990, the Air Pollution Act, 1987 and the Environmental Protection Agency Act, 1992 (EPA Act). They are accompanied by the many Regulations made under the European Communities Act, 1972.

Prior to the establishment of the EPA in 1993, Local Authorities had primary responsibility for environmental protection and the issuing of pollution control licences to potentially polluting activities. With the establishment of the EPA, responsibility for licensing is now shared between the Agency and the local authorities with the licensing of scheduled activities, i.e., those requiring an integrated pollution control (IPC) licence, being transferred to the EPA on a phased basis and non-IPC licensed activities remaining under the jurisdiction of local authorities. Comprehensive noise control legislation has also been enacted under the EPA Act.

The best environmental policy is to plan for the prevention or minimisation of adverse effects on the environment at the project planning stage, when pollution prevention and control and environmental protection strategies can be incorporated at least cost into the project. IPC licensing provides the framework for the implementation of this policy for scheduled activities.

The Local Government (Water Pollution) Acts, 1977 and 1990, and the Air Pollution Act, 1987, provide the Local Authorities with wide ranging powers of enforcement in relation to emissions to water and air from activities under their control. These Acts also empower Local Authorities to adopt water quality and air quality management plans for the preservation and/or improvement of water and air quality in their areas.

Regarding the regulation of solid waste, current Irish waste legislation principally consists of Regulations for the implementation of relevant EU Directives. These are described in Chapter 7 of this report. Local authorities are responsible for all waste management matters at present and are obliged to prepare both waste management plans and hazardous waste management plans for their areas. The Waste Management Bill, 1995, proposes radical changes to waste management practice in Ireland and provides for a licensing role for the EPA. Comprehensive national legislation exists in relation to litter (see Chapter 7).

Conservation

The principal national legislative instruments governing conservation in Ireland are the Local Government (Planning

and Development) Acts, 1963-1994 and the Wildlife Act, 1976. These are accompanied by several EU statutes including the wild birds Directive and the habitats Directive and other domestic statutes such as the Foreshore (Amendment) Act, 1992. Conservation measures stemming from these statutes are outlined in Chapter 12.

Under the Local Government (Planning and Development) Act, 1963, planning authorities are required to prepare development plans which are to be reviewed every five years. There are comprehensive public consultation procedures attached to the review of development plans and all submissions and observations by interested groups must be taken into consideration before the plans are adopted by the elected members. Generally, development plans provide a framework for infrastructural planning, development control and aspects of environmental protection. Regarding environmental protection, development is to be controlled in areas of outstanding natural beauty and amenity, areas of scenic importance, views and prospects of amenity value and other areas of amenity value. Planning authorities may also be required to have regard to the views, advice or recommendations of the EPA. Furthermore, some Directives, including the wild birds Directive and habitats Directive may require land-use and development policies to be adapted in order to protect habitats and species. Development plans also provide the framework for land zoning and the granting or refusal of planning permission for proposed developments.

STRATEGIES AND TOOLS

Environmental protection strategies and tools generally evolve from policy and legislative instruments. Ireland's environmental policy, in common with that of the EU, is based on the following principles:

- the principle of sustainability;
- the precautionary principle;
- the integration of environmental considerations into all policy areas;
- the polluter pays principle;
- the principle of shared responsibility between public authorities, private enterprise, voluntary bodies and the general public.

Environmental protection firstly requires broadly-based protection, planning and conservation strategies, the most important of which are:

- Land-Use Planning and Land Zoning;
- Nature Conservation;
- Landscape Conservation;
- Coastal Zone Protection.

The transposition of the policy principles set out above into practical actions also requires the adoption of realisable strategies, plans and methodologies for use by public and private enterprises with a significant polluting capacity. These actions may include:

- Integrated Pollution Control;
- Local Authority Licensing and Control;
- Environmental Impact Assessment;
- Risk Assessment/Risk Management;
- Mass Balance Inventories;
- Environmental Auditing;
- Environmental Management and Planning;
- Waste Minimisation Practices;
- Clean Production Technologies;
- Re-use, Recovery and Recycling Strategies;
- Safe Treatment and Disposal Practices.

These strategies and their use in Ireland are summarised later in this chapter.

General Environmental Protection

Land-Use Planning and Zoning

At present, major planning decisions are made within the context of County development plans and EIA. Decisions are made on a site-specific basis. Much of the land in Ireland is currently unzoned in existing development plans which, in effect, means that a factory could be built almost anywhere in an unzoned area. Every development has some impact on the environment and, cumulatively, these may become significant. There is a need for uninterrupted areas with little or no development to maintain and foster biodiversity. Planning can provide protection for such areas, and can be reinforced by measures such as water quality management plans and similar plans, preferably integrated, for air, waste and noise.

The requirement for a national zoning policy or land-use environmental quality objectives (EQOs) needs to be examined. In the case of industry, it is desirable that a much stronger policy of zoning industrial areas is developed. This would involve the identification and zoning of specific areas for this purpose. Industrial development outside such areas should be the exception.

Nature Conservation

A number of trends have been identified in the development of nature conservation policies in recent years in Europe (Stanners and Bourdeau, 1995), which, by and large, are reflected in Ireland. The most important of these are trends:

- a) towards the protection of habitats and the natural processes upon which threatened species and habitats depend; away from the simple protection of species;
- b) towards the integration of nature conservation into the planning and management of the terrestrial and marine environment as a whole, and into each economic sector, away from nature protection as an isolated exercise;
- c) towards co-ordinated programmes of international co-operation, in which standards and criteria are agreed internationally, away from isolated local or national initiatives;
- d) towards a recognition of the importance of ecosystems and biodiversity as an integral part of sustainable development, away from the simple conservation of nature for its scientific and aesthetic qualities.

This radical shift in policy, which was reinforced at UNCED in 1992, will position nature conservation and, in particular, the conservation of biological diversity, at the heart of local, regional and global development planning in the future.

In practice, however, nature conservation actions are still directed either at the protection of species or the protection of sites, although recent initiatives are aimed at integrating nature conservation into national and regional planning. National nature conservation initiatives are described in detail in Chapter 12.

There is a profusion of designations assigned to protected areas, and this is a symptom of the fragmented approach to conservation practised up until recently. Generally, the international trend is now towards integrating nature conservation into the planning and development process and extending the principles of conservation to the rehabilitation and restoration of damaged habitats. Protected areas can no longer be treated as islands of conservation. To this end, the following key areas for action are identified (Stanners and Bourdeau, 1995):

- the integration of biodiversity conservation with national planning for sustainable development, in response to Agenda 21 and implementation of the Convention on Biological Diversity;
- the integration of nature conservation with the planning and management of land-use;
- the integration of nature conservation and the planning and management of the marine environment;
- the integration of nature conservation with pollution control;
- the involvement of local communities in the management of protected areas.

Conservation of biodiversity has taken on a new urgency since the UNCED. There is a growing realisation that conventional environmental protection, which aims at preventing damage to the environment, needs to be complemented with new policies aimed at the rehabilitation and restoration of environmental damage. Natura 2000 (see Chapter 12), for instance, promotes actions being taken outside protected areas and introduces the principles of sustainability for all forms of natural resource management (Stanners and Bourdeau, 1995).

Landscape Protection

There is considerable overlap between the mechanisms used in Ireland for landscape protection and nature conservation. Clearly, the two are intrinsically linked: as the landscape is changed through human activities, natural habitats will also be affected. Similarly, the protection of landscape, particularly in scenic areas, is likely also to afford protection to associated habitats. Landscapes are protected primarily through their inclusion in County development plans as areas of outstanding natural beauty or amenity, areas of scenic importance, views and prospects of amenity value, or, other areas of amenity value. There is a general public right to comment on all planning applications made to a planning authority and any person may appeal to An Bord Pleanála against any decision of a planning authority. Bodies specifically interested in landscape protection, such as An Taisce and Bord Failte, have special consultation rights in the case of all planning applications in areas of special amenity value, or where these might interfere with protected views or prospects.

Other measures which contribute towards landscape protection include EIA, Special Amenity Area Orders, Tree Preservation Orders and the provisions of the Derelict Sites Act, 1990. Sites that are designated as protected areas for nature conservation purposes and provided with legal protection for such are also, *de facto*, protected for landscape purposes, as development within such areas is either prohibited or strictly controlled. These include nature reserves, national parks, protected wetlands, biogenetic reserves and national heritage sites.

Coastal Zone Protection and Management

The Irish coastline is a resource of immense value in economic, environmental, ecological and social terms. However, in recent years it has become generally accepted that coastal erosion is a major threat to the coastal environment (Department of the Environment, 1994a). Other pressures on the coastal zone include point and non-point waste water discharges, litter, and long-term risks associated with projected rises in sea-level. All of Ireland's large cities and many of its towns are located along the coast. The coastal zone, in common with the inland landscape, has therefore undergone enormous change.

The Coastal Protection Sub-programme of the Operational Programme for Environmental Services, 1994-1999 (Department of the Environment, 1994a), seeks to address the most urgent coastal erosion problems identified on the Irish coast. The programme also identifies the need for coherence in the approach to coastal zone management due to the many public bodies responsible for or using the coastal zone. Immediate actions under the programme are the construction of soft (e.g., beach replenishment) and hard coastal works in priority sites and the development of a comprehensive management policy for the entire coastal zone, both on the seaward and landward sides.

There are essentially three options for dealing with coastal erosion: retreat, accommodate or protect. The most viable option in Ireland is a combination of accommodation to changing circumstances and protection or reduction of the physical impact of erosion.

While erosion is a natural process, human activities have a large impact on its rate and extent. Coastal activities, including tourism and the removal of beach material, can lead to localised damage of the coastline with sand dunes and sandy beaches being particularly sensitive to damage. The construction of hard defences also needs to be considered carefully as they can have knock-on effects in neighbouring localities, leading to increased erosion or silting. The Foreshore (Amendment) Act, 1992, gives the Minister for the Marine power to ban sand or stone removal from any beach or classes of beach and to ban any activity which is deemed to disturb the seashore.

The coastal zone is exposed to pollution from numerous sources. Specific measures to reduce inputs from individual sources have been dealt with in other parts of this report. They include the urban waste water treatment Directive, the Marine Conventions and IPC licensing.

The complex nature of the coastal zone and the many potential inputs into it require an integrated approach to its protection and management, the development of which is catered for in the Coastal Protection Sub-programme. Many of the environmental protection tools described in this chapter including EIA, risk assessment, IPC, BATNEEC, environmental management planning, waste prevention and waste treatment are relevant to coastal zone management.

The Department of the Environment, the Department of the Marine, and the Department of Arts, Culture and the Gaeltacht are working on the development of an integrated national policy for coastal zone management. The initiative aims to put in place a coherent framework for sustainable coastal development concerning such areas as development planning, coastal protection, nature conservation and

marine environmental protection. Mechanisms to promote greater co-ordination among the various statutory agencies and other interests active in the coastal area, as well as procedures to avoid or, where necessary, resolve conflicts of use will be addressed in the policy statement.

Consultants have been appointed to prepare a strategy document on coastal zone management in Ireland as an aid to policy formulation and their report is expected early in 1996. The final report will take account of submissions from the general public and special interest groups and will itself be subject to a public consultation process prior to the completion of national policy for this area.

In 1992, an initiative at Local Authority level led to the production of a report for Wexford County Council on a Coastal Zone Management Plan for the Wexford coastline, aspects of which were incorporated into the County Wexford Development Plan.

Tools for Environmental Protection

Integrated Pollution Control and BATNEEC

IPC licensing is one of the principal environmental protection instruments to be adopted in Ireland. Ultimately, all new and existing facilities in the State with a significant pollution generating capacity will be subject to IPC licensing. With IPC, there is a strong emphasis on pollution prevention, and companies licensed under IPC are required to operate an environmental management system as a condition of the licence. IPC is a dynamic process which provides for continuing improvement.

At the heart of the IPC process is BATNEEC. The boxes below present a summary of the introduction of IPC licensing and BATNEEC to Ireland. The draft EU Directive on Integrated Pollution Prevention and Control (IPPC) proposes a similar system to that operating in Ireland for all Member States.

Integrated Pollution Control (IPC) in Ireland

IPC licensing was introduced to Ireland with the establishment of the EPA. The licensing function of the Agency commenced on 16 May 1994 and is being expanded on a phased basis. The First Schedule of the EPA Act lists all of the new and established activities that will require an IPC licence to operate. The thirteen major categories of activity in the First Schedule are as follows:

1. Minerals and Other Materials;
2. Energy;
3. Metals;
4. Mineral Fibres and Glass;
5. Chemicals;
6. Intensive Agriculture;
7. Food and Drink;
8. Wood, Paper, Textiles and Leather;
9. Fossil Fuels;
10. Cement;
11. Waste;
12. Surface Coatings;
13. Other Activities.

By December 31, 1995, over 90 companies had applied to the EPA for an IPC licence (see Table 14.1). The EPA estimates that almost one thousand companies will require an IPC licence in future years.

Table 14.1 Applications Received by EPA for IPC Licences by 31 December, 1995.

Class of Activity	Description	Number of Applications Received (by 31 Dec, 1995)
1	Minerals & Other Materials	3
2	Energy	1
3	Metals	1
5	Chemicals	55
7	Food and Drink	15
8	Wood, Paper, Textiles & Leather	5
10	Cement	2
11	Waste	9
12	Surface Coatings	4

BATNEEC

BATNEEC is the acronym for Best Available Technology Not Entailing Excessive Cost. The technology should be the Best at preventing pollution and Available in the sense that it is procurable by the industry concerned. NEEC sets out the balance between environmental benefit and financial expense. In the identification of BATNEEC for a given sector, emphasis is placed on pollution prevention techniques, including cleaner technologies and waste minimisation, rather than end-of-pipe treatment. Where end-of-pipe treatment is required, emission limit values are specified. The EPA issues BATNEEC guidance notes for use by each sector. These notes specify current

BATNEEC technologies and associated emission limit values for the sector.

BATNEEC also has environmental management implications as it is construed in the EPA Act, as meaning the provision and proper maintenance, use, operation and supervision of facilities which, having regard to all the circumstances, are the most suitable for the purposes.

Local Authority Licensing and Control

Local authorities are empowered by the Local Government (Water Pollution) Acts, 1977 and 1990, and the Air Pollution Act, 1987, to issue air and water pollution control licences. Prior to the establishment of the EPA, local authorities had primary responsibility for environmental protection and the issuing of pollution control licences. In their capacity as planning authorities, local authorities are also empowered to attach environmental protection conditions to planning permissions granted by them, provided the activity does not require an IPC licence.

Environmental Impact Assessment

The legislative instruments for EIA in Ireland are described earlier in this chapter. EIA is still a relatively new practice in Ireland and, as in other jurisdictions, it is evolving through practical experience. The EPA recently issued Draft Guidelines (Environmental Protection Agency, 1995) on the content of environmental impact statements (EISs). The Guidelines are intended to provide developers, competent authorities and the public at large with an agreed basis for determining the adequacy of EISs, within the context of established development consent procedures. The Guidelines will also facilitate the development of standardised procedures for conducting EIA and EIS in Ireland and in 1997 will be formally issued under Section 72 of the EPA Act, following a two-year review period.

Since Directive 85/337/EEC on the assessment of the effects of public and private projects on the environment came into force in July 1988, EIA has been carried out on a relatively large number of projects in Ireland. Between July 1988 and December 1990 a total of 123 EISs were submitted to competent authorities.

Risk Assessment

Risk Assessment (RA) is the practice of predicting the risks to human health and the environment of industrial, agricultural and domestic activities. As all human activity has a potential impact on the environment, RA is used to establish an acceptable level of risk for a given activity. It is also used to estimate the cost-effectiveness of different actions by estimating the incremental gains to be made from them and is therefore an important decision-making tool.

RA is particularly important where limited resources are available to deal with environmental protection and pollution prevention and control. A practical example of the use of risk assessment is presented in the box below.

Risk Assessment (RA)

Contaminated Site Clean-up

RA is being used increasingly to determine appropriate levels of treatment for the remediation of contaminated sites, a problem more endemic in heavily industrialised countries than in Ireland. As with the treatment of urban wastewater, the higher the level of treatment the greater the costs and RA can help determine the level and type of remediation which will reduce the risk to human health and the environment to an acceptable level. For instance, many old underground storage tanks are now known to have leaked and contaminated surrounding soil, resulting in an unacceptable risk to human health and the environment. To reduce this risk to an acceptable level, the soil must be either cleaned or contained on-site or removed and cleaned or contained off-site. RA can be used to determine the risk associated with different strategies ranging from no treatment to returning the soil to a clean state, so that a safe and cost-effective remediation programme can be implemented.

Mass Balance Inventories

Companies licensed by the EPA are required to submit information on emissions for inclusion in a Pollution Emissions Register. The Mass Balance Inventory, as proposed in the Waste Management Bill, 1995, provides powers to extend effectively this requirement to non-IPC licensed activities. It is proposed that a person carrying out a specified process or operation can, by Ministerial Regulation, be required to conduct mass balances of regulated substances determining the relationship between the release of such a substance into the environment and the use and/or consumption of such a substance in a process, development or operation. It is anticipated that the introduction of such practices will lead to reduced usage of toxic substances in processes and, by extension, reductions in the amounts of such substances emitted into the environment.

Environmental Auditing, Management and Planning

Measurable progress towards the environmental goals set in national and European policies requires the widespread adoption of an environmental management and planning culture amongst all sectors (both public and private) with a significant polluting potential. Large manufacturing industries

are increasingly moving towards the adoption of environmental management systems and will be particularly attracted to such an approach where cost savings can be made through better environmental management. Perhaps the most significant international development in this regard is the forthcoming publication of the ISO 14000 series of environmental standards by the International Standards Organisation (ISO). ISO 14000 is intended to be the worldwide environmental equivalent of ISO 9000, the manufacturing quality standard implemented in more than 90 countries. The ISO 14000 series of standards will focus on environmental management.

The National Standards Authority of Ireland recently published Irish Standard (IS) 310, *Environmental Management Systems: Guiding Principles and Requirements* (National Standards Authority of Ireland, 1994), a national standard for environmental management systems. The publication of IS 310 was in response to the EU Eco-Management and Audit Scheme (EMAS). The National Accreditation Board has been designated by the Government to administer EMAS, which came into operation in April, 1995. One of the main objectives of EMAS is to facilitate manufacturing concerns in identifying their potential for waste minimisation. It is intended that manufacturing concerns which participate in the scheme could be exempted from certain mandatory waste prevention obligations which may be imposed under the Waste Management Bill (Department of the Environment, 1995c).

Public and private enterprises which adopt an environmental management planning approach to their activities are, in effect, working in co-operation with the regulatory authority and become, to a large extent, self-regulating. The adoption of an environmental management culture is an integral part of the IPC process and, to this effect, activities licensed by the EPA are required to put an acceptable environmental management system in place as a condition of the licence. In the agricultural sector, farmers participating in the Rural Environmental Protection Scheme (REPS) are required to prepare an agri-environmental plan for the farm, which introduces the concept of environmental management planning to the farm (see box).



The Rural Environmental Protection Scheme (REPS)

Under EEC Regulation 2078/92, Governments can define certain areas as being important for conservation of biodiversity, landscapes or cultural features, where those qualities depend on the survival of traditional forms of farming. Farmers in such areas are then eligible for grants, to which the EU makes a contribution, to ensure that such traditional farming is maintained, with appropriate safeguards for environmental protection. In effect, a contract is made with the farmer to protect the landscape and other environmental qualities on the land in return for financial support for the farming system which sustains those qualities (Stanners and Bourdeau, 1995).

The Department of Agriculture, Food and Forestry launched REPS in June 1994. The main objectives of the Scheme are to establish farming practices and controlled production methods which encourage conservation, landscape protection and the preservation of natural habitats. The rate of grant assistance to farmers is approximately £122 per hectare, up to a maximum of 40 hectares per annum over five years. Farmers with land in excess of this amount have to implement the REPS measures on all of their land.

The scheme also provides for extra payments to farmers who:

- avoid degradation of land in hill areas;
- preserve natural heritage areas and areas of scientific interest;
- make land available for public access and leisure activities;
- engage in organic farming;
- set aside an area of land beside a river (a riparian zone);
- rear animals of local breeds in danger of extinction.

By mid-1995, some 4,500 farmers had applied for REPS and almost 150,000 hectares of land were covered by the scheme.

(Source: Department of Agriculture, Food and Forestry).

Waste Prevention and Minimisation/Clean Production

The preferred approach to pollution prevention/control and environmental protection is to prevent or minimise solid, liquid and gaseous wastes from being generated in the first

place. Solid, liquid and gaseous emissions to the environment can be reduced at source through the reformulation of products and processes and the adoption of clean technology. Waste prevention/minimisation and clean production are practical technological approaches to environmental protection which can be embraced by the manufacturing sector in particular. Increased consumer demand for clean products together with a stricter regulatory environment makes it economically sensible for many companies to re-evaluate their processes to see where improvements can be made.

The production of waste often means the loss of valuable resources and many manufacturing processes can be made more efficient and more environmentally acceptable. This can occur through the adoption of better operational and maintenance procedures as well as through product and process reformulation.

In 1993, the Department of the Environment issued a discussion document on the use and application of clean technology in Ireland (PA Consulting Group, 1993). Approximately 20 senior managers and directors of manufacturing companies were interviewed, with the following objectives:

- to gauge awareness of cleaner technology as an issue of importance to their business and of any specific cleaner approaches;
- to identify barriers to the uptake of cleaner approaches;
- to determine the current level of support available to implement cleaner approaches and to receive suggestions for further support.

A range of educational establishments and national agencies with a role in the development of clean technology were also canvassed for their opinions.

The identified barriers to uptake of cleaner approaches included general lack of awareness of the benefits of clean technology at senior management level, cost/benefit justification difficulties, perceived risk in dealing with new and sometimes unproven technologies, technology transfer limitations especially for small companies, external constraints such as disruption of manufacturing processes, and finally, lack of investment capital.

According to the Department of the Environment document, the promotion of cleaner technologies in Ireland has to-date been limited to the activities of a small number of higher educational institutions supported by the Department, in particular, the UCC Cleaner Production Promotion Unit and Cork RTC Clean Technology Centre. To have a wider impact, and provide a greater momentum, the report recommends that future promotional

programmes should be established in the context of a co-operative framework involving higher educational institutions, state agencies concerned with industrial development and industry associations.

Re-use, Recovery and Recycling

Where waste is produced, the preference accorded by the waste management hierarchy is for re-use, recovery or recycling (see Chapter 7). The national recycling strategy, *Recycling for Ireland*, sets out national recycling targets for packaging materials, as earlier discussed. Generally, re-use, recovery and recycling rates are considerably lower in the municipal and commercial sectors than in the industrial and agricultural sectors. In 1994, it was estimated that the overall recycling rates for household waste, commercial waste and packaging wastes were 1.4 per cent, 14.5 per cent and 10.3 per cent, respectively.

In the industrial/manufacturing sector, Forbairt estimate that of the 1,306,000 tonnes of industrial waste produced by the manufacturing sector in 1991, 664,000 tonnes (50.8 per cent) were recovered for re-use as secondary raw materials. Of the 79,802 tonnes of hazardous waste managed in Ireland in 1992, 46,981 tonnes (58.9 per cent) were either recovered or recycled.

Considerable efforts are required to improve rates of recycling, re-use and recovery in the household and commercial sectors. In the industrial sector, improvements in this area will derive from better environmental management planning and a greater awareness of the market benefits to be gained through better environmental practice.

It is important to recognise that far greater long-term benefits will accrue through waste prevention than through re-use, recovery and recycling. Environmental protection strategies need to be implemented with this in mind.

Waste Treatment

Waste treatment can be defined as any action which reduces the polluting capacity of a given solid, liquid or gaseous waste stream.

A wide array of biological, chemical, physical and thermal processes can be used to treat waste streams. The treatment of waste often results in the production of secondary wastes which, while less polluting, may require further treatment prior to either re-use, recovery, recycling or safe disposal. This is particularly true for the treatment of liquid and gaseous effluents where a sludge is often the by-product of the treatment process. Likewise, incineration of solid or liquid wastes results in the production of gaseous emissions and a solid residue. This highlights the need for an integrated approach to waste management so that all

potential environmental emissions are accounted for when considering any given activity. An integrated approach provides greater protection for what have been the least regulated media, namely land and the ocean.

While waste prevention and minimisation is the preferred approach, a large volume of solid, liquid and gaseous waste continues to be produced and requires treatment prior to discharge into the environment to minimise the impact on both human health and the environment.

Safe Disposal

Safe disposal is the final step accorded by the waste management hierarchy after all other options have been considered. There remains a wide gap between policy and practice in this regard as a vast quantity of waste which could be re-used, recovered or recycled continues to be disposed of on land. There will continue to be a large quantity of waste produced that is non-recoverable and will require safe disposal. In Ireland, landfilling will continue to be the principal method of disposal for non-recoverable solid waste. The EPA is currently preparing criteria and procedures for the selection, management, operation and restoration of landfill sites for domestic and other wastes.

The Waste Management Bill provides for licensing of landfills, along with other waste disposal and recovery operations, with the EPA designated as the licensing authority. It can be expected that design and operational requirements for the landfilling of waste in the future will be far stricter and more comprehensive than those that applied in the past.

SUMMARY AND OUTLOOK

A broad overview of the strategies and tools used for environmental protection both in Ireland and abroad is presented in this chapter. The environment, by its very nature, is a complex entity and the tools and strategies required for its protection are drawn from many disciplines. In the past, environmental protection tended to be viewed in isolation. The environment was viewed as a collection of separate compartments without due consideration being given to the intricate and complex interactions that occur between these compartments. Human activities have also tended to be considered as somehow separate from the environment, with the environment there to be controlled and developed. This is being replaced by a more broadly-based ecological approach to understanding the environment and how people interact within it which recognises that the development of a sustainable economy is dependent on the maintenance of a healthy and clean environment.

An example of the development of more broadly-based approaches is the recent policy document from the Department of the Environment on a strategy to protect lakes against eutrophication.

The future development of environmental protection in Ireland will be strongly influenced by the translation of the policy statements into action. Examples to date include the creation of EPA, the introduction of IPC licensing, the publication of IS 310, the publication of the Waste Management Bill and the general trend towards integrated planning.

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COMHAIRLE CHONTAE LOCH GARMAN
WEXFORD COUNTY COUNCIL Helping Your Environment

DUNE RESTORATION WORKS

- Public use and tramping by horses is wearing away the grass cover on the dunes allowing the wind to further erode the fragile dune system.
- If this continues unchecked much of the existing sand dunes will disappear over the next few years, along with the wonderful plant and animal life these dunes support.
- Some badly eroded dunes are now being restored and Wexford County Council's Environment Section is overseeing the re-establishment of vegetation and other works. New dunes are also being encouraged along the foreshore at areas under most threat.
- The methods used to do this are shown on the right:
 - fences and screens to trap the blown sand,
 - the planting of grass and shrubs to stabilize the dunes &
 - the maintenance of boardwalk pathways to the beach.
- This and other amenity work is costing several thousand pounds each year and if it succeeds Curragh will be a better place to come to. But it cannot succeed without your co-operation.
- So please keep off the dunes as much as possible and do not interfere with the fences and other works.
- Footpaths have been provided across the dunes and are clearly marked. Please follow them.
- Tell others, who have not read this notice what we are trying to do.

Thank You

FENCES
To protect the planting and trap the sand

GRASS & SHRUBS
To fix the dunes

SIGNPOSTS
To mark the paths through the dunes






ECONOMIC ASPECTS

INTRODUCTION

This chapter reviews specific economic aspects of the environment. The European Union (EU) and national contexts are each considered briefly in turn. In addition, expenditure on the environment and the general question of economic instruments are also covered. Issues related to sustainability are addressed more specifically in Chapter 16.

EU FIFTH ACTION PROGRAMME ON THE ENVIRONMENT

At the EU level, the Fifth Action Programme on the Environment, under the title of *Towards Sustainability*, aims at broadening the range of instruments for achieving sustainable development. Included among these are the following:

- the economic approach
- financial support mechanisms.

The Economic Approach

The EU Programme envisages a major role for *economic and fiscal instruments*. The fundamental aim of these instruments is that prices should reflect all external environmental costs incurred during the whole life-cycle of products. This would help ensure that environmentally friendly products would not be at a competitive disadvantage vis-a-vis products which cause pollution and waste. The instruments include the following:

- charges and levies (aimed at discouraging pollution at source);
- fiscal incentives (e.g., differential duties on unleaded and leaded petrol; carbon tax);
- State aids (where compatible with the 'polluter pays' principle), e.g., subsidies for particular types of environmental expenditure;
- environmental auditing ('as important as traditional financial accounts')
- an integrated Community approach to environmental liability (as a last resort to punish despoilation of the environment).

It is difficult to place a monetary value on many environmental assets. Nevertheless valuations, pricing and accounting mechanisms have a pivotal role to play towards achieving the objectives of the Programme. In this respect the following are among the measures envisaged at EU level:

- evaluation of the natural and environmental resource stocks in economic terms;
- development of renewable resource indicators to show the rates at which natural resources are used and renewed;

- modification of key economic indicators, such as gross national product (GNP), to reflect the value of natural and environmental resources;
- development of meaningful cost/benefit analysis methodologies;
- redefinition of accounting concepts, rules, conventions and methodology to include environmental resource costs.

EU Financial Support Mechanisms Related to the Environment

STRUCTURAL FUNDS

European Regional Development Fund (ERDF)

Operational Programme (OP) for Water, Sanitary and Other Local Services (1989-1993)

OP for Environmental Services (1994-1999)

European Social Fund (ESF)

European Agricultural Guidance and Guarantee Fund (EAGGF) - Guidance element

Farm Improvement Programme (1986-1993)

Pollution Scheme under the Programme for Western Development (1988-1989)

OP for the Control of Farmyard Pollution (1989-1993)

Pilot Environmentally Sensitive Areas Scheme (1992-1994)

Farm Improvement Programme (1994-1999)

Control of Farmyard Pollution under the current OP (1994-1999)

Research in Sustainable Agriculture and Rural Development (1994-1999)

European Agricultural Guidance and Guarantee Fund (EAGGF) - Guarantee element

Rural Environment Protection Scheme (REPS) - including organic farming (1994-1997)

COMMUNITY FINANCIAL INSTRUMENT FOR ENVIRONMENT (LIFE)

COHESION FUND

EUROPEAN INVESTMENT BANK LOANS

Financial Support Mechanisms

Financial support mechanisms must not have the effect of decreasing the fundamental responsibility of the relevant economic sectors. The EU Fifth Action Programme on the Environment presents general and theoretical concepts. These are, of necessity, developed and qualified as appropriate in more detailed individual plans being prepared for action in specific sectors and areas. The Programme mentions the following financial mechanisms:

(a) Structural Funds

The Structural Funds comprise the following:

- European Regional Development Fund (ERDF), which includes investment in infrastructure aimed at environmental protection;
- European Social Fund (ESF), which includes support for training in the environment;
- the guidance element of the European Agricultural Guidance and Guarantee Fund (EAGGF), which includes rural development and environmentally friendly farming.

The reform of the Structural Funds will focus on the intrinsic strengths and natural resources of the designated regions in promoting sustainable development. Increasingly, the Common Agricultural Policy (CAP) will be linked to environmentally friendly practices.

(b) Community Financial Instrument for Environment (LIFE)

LIFE contributes to the development and implementation of EU environmental policy by financing demonstration projects under the headings:

- promotion of sustainable development and the quality of the environment;
- protection of habitats and nature;
- administrative structures and environment services;
- education, training and information.

(c) Cohesion Fund

This fund supports projects on the environment and trans-European transport networks. Financing is subject to certain conditions. Environmental projects, or groups of related projects, must be of sufficient scale to have a significant impact on environmental protection, and must contribute to the achievement of Community environment policy priorities and legislation.

(d) European Investment Bank (EIB)

The EIB has adopted environmental protection as an important criterion for project selection and appraisal.

Projects in Ireland Approved under the Community Financial Instrument for Environment (LIFE)

The 1993 LIFE fund supported eight projects in Ireland. These projects covered such topics as nutrient management planning, recycling, effluent reduction, catchment development, national scenic parks, training and awareness in environmental impact assessment (EIA), an environmental inventory for Dublin, and a survey of Natural Heritage Areas (NHAs). The LIFE fund allocated £3.28 million to these projects. Eight Irish environmental projects were approved to receive a total of £5.06 million under the EU LIFE 1994 Fund. The 1994 projects are as follows:

Development and demonstration of an emission-free process for crystal glass manufacture (Waterford Crystal Ltd.);

Maximisation of material recovery and minimisation in the usage of fresh water (North Kerry Milk Products Ltd.);

Establishment of a glass/aluminium recovery system in a rural area using wheel-bin based drop-off centres (Wexford County Council);

Management plan for sustainable use of Lough Gill and its environment (Sligo County Council);

Tourism Eco-labelling Plan (Udaras na Gaeltachta);

Development of an environmental information management system for Ireland (Environmental Protection Agency);

Irish-Danish-French co-project on Environmental Management and Auditing (Clean Technology Centre, Cork RTC);

Acquisition of nature conservation sites and survey of Areas of Scientific Interest (National Parks and Wildlife Service).

THE NATIONAL DEVELOPMENT PLAN AND THE COMMUNITY SUPPORT FRAMEWORK

The National Development Plan (NDP) 1994-1999 stated that a report on the quality and condition of the environment would include an assessment of the impact of development policies and investments under the Plan. A

primary objective of the plan is to enhance economic performance through sustainable growth and development. Since the present report on the quality and condition of the environment is being prepared relatively early in the period covered by the plan, the assessment is largely prospective, and based mainly on the experience in the 1989-1993 period.

The Community Support Frameworks (CSF), which form the contracts between the Member States and the Commission, require conformity with environmental legislation and assessment of the environmental impact of projects. Building on the NDP, the CSF for Ireland 1994-1999 has identified strategic goals and has set quantified environmental objectives. These are to be met by direct investment and by changes in sectoral policy. CSF requires co-financed measures to "abide by the principles and objectives of sustainable development" set out in the Fifth Action Programme and to comply with Community legislation on the environment. The importance of valuations, pricing and accounting mechanisms is stressed. The Environment Policy Research Centre of the Economic and Social Research Institute (ESRI) is conducting ongoing examination of the economic aspects of environmental policy and investment, to establish relevant economic principles and measurements in an Irish context.

The EU STRIDE Programme

The EU STRIDE Programme (Science and Technology for Regional Innovation and Development in Europe) was an example of a Commission initiative under the previous Community Support Framework. It included separate sub-programmes for the marine, environment, forestry and food sectors.

The approved expenditure under the Environment Sub-programme was £3.566 million, of which £2.527 million was EU funded (an average of 71 per cent EU financing). The STRIDE Programme provided for actions under three headings as follows:

- upgrading and expansion of laboratory facilities;
- environmental research co-ordination and management, and inter-laboratory calibration;
- a research fund which supported nine applied research projects.

Ireland's reputation as a clean and green country gives it an important opportunity for competitive advantage in the agriculture, food and tourism sectors and for the promotion of branded Irish products and high quality industry and services. Maintaining a sound environment and natural resource base will help ensure the future well-being of these activities and their associated employment.

In parallel with effective controls, increased economic activity must be supported by modern, efficient environmental infrastructure. Major co-financed investment totalling about ECU 750 million over the CSF period is proposed on water, sanitary and environmental services with the aid of Cohesion and Structural Funds. A national strategy has been prepared for implementing the urban waste water treatment Directive and for managing sewage sludge.

Against the background of a derogation to meet required national economic expansion, Ireland published in 1993 and submitted to the European Commission a national CO₂ abatement strategy. This is Ireland's contribution to the overall EU commitment to stabilise Community CO₂ emissions at 1990 levels by the year 2000 (Department of the Environment, 1993a). There are proposed actions on energy conservation, fuel use, transport, waste management and afforestation. Account was taken of the strategy in the formulation of relevant sectoral proposals under the CSF.

Summary of Community Support Framework (CSF) Environmental Objectives

The CSF environmental objectives are as follows:

- to improve the quality of public and group water supplies;
- to increase the proportion of urban waste water being treated;
- to end the dumping of sewage sludge at sea;
- as far as possible, to eliminate serious pollution of rivers;
- to stabilise waste arising from municipal households at 350 kg/annum per household;
- to achieve an increased recovery rate for packaging waste and a substantially increased recycling rate of municipal solid waste;
- to support the continued development of appropriate infrastructure for the management of hazardous waste;
- to strengthen the protection of coastal areas;
- to give statutory protection to an increasing area of land of conservation importance.

EXPENDITURE ON THE ENVIRONMENT IN IRELAND - GENERAL CONSIDERATIONS

Before considering the Operational Programme (OP) for Environmental Services 1994-1999 under the CSF, some general consideration is given in this section to the question of expenditure on the environment in Ireland, as well as to previous expenditure and its evaluation.

Substantial levels of investment are made in the provision of environmental infrastructure. In addition, environment related expenditure is undertaken on a much broader basis both at Government and at Local Authority levels. Industry and public utilities also make a significant investment in meeting the cost of environmental regulations. A growing market exists for environmental consultancy, for environmental research and in the area of environmental technology and services.

Total expenditure on the environment is very difficult to quantify, both because much of the data has never been aggregated, and because the full range of 'environmental expenditure' is not clearly defined.

In 1994, over £230 million was spent by Government on a range of environment related programmes and activities. These included water services, national parks and wildlife, inland waterways, control of farmyard pollution and the new Rural Environment Protection Scheme (REPS), energy conservation, coastal protection and environment related research and development.

In addition to Government Departments, public bodies with direct or indirect environmental remits include the Environmental Protection Agency (EPA), the Marine Institute, Teagasc (the Agriculture and Food Development Authority), the Health and Safety Authority and the Radiological Protection Institute of Ireland.

Environment related spending accounted for at least 33 per cent, or £370 million, of Local Authority budgets in 1994. On a country-wide scale, the Department of the Environment (DoE) estimates that almost 40 per cent of the 30,000 staff employed by all Local Authorities are directly or indirectly involved in the management, delivery and maintenance of environmental services.

These efforts are complemented by environmental spending in the semi-state and private sectors. For example, the Electricity Supply Board (ESB) has provided for £10 million in respect of the installation of low-NO_x burners and has made a budgetary provision of £45 million for environmental improvements over the next five years in generation, transmission and distribution activities.

A further example is Bord na Mona which invests annually in a number of environmental control activities, including the development of alternative environmentally friendly products, such as biofilters. The annual cost of silt control is in excess of £2 million, which is spent on the excavation and maintenance of 600 silt control ponds covering drainage outfalls from 80,000 ha of peatland. Up to £0.5 million has been spent on an environmental control system to reduce emissions from briquette factories. Bord na Mona has spent £2.5 million to date on research leading to the development of the relevant technologies for the future use of all emerging cutaway peatlands under its control.

It is difficult to assess the rate of investment by industry as a whole in environmental protection. In Ireland it has been tentatively estimated that manufacturing companies will invest upwards of £500 million during this decade in environmental protection facilities. Much of this is as a result of the introduction of integrated pollution control (IPC) (see under 'Industry' below) which aims *inter alia* at reducing pollution at source and reducing resource usage. The question of environmental expenditure by industry in general is further addressed later in this chapter. Taking all identifiable direct spending on environmental measures into account, it is estimated, possibly conservatively, that this investment represents about 2 per cent of gross domestic product (GDP).

EXPENDITURE ON ENVIRONMENTAL SERVICES 1986-1994

The total capital investment in water and sanitary services in the period 1986-1994 was £738.33 million, of which £305.8 million was spent on water and £432.53 million on sewerage. The annual expenditure on these services over the period is shown in Fig. 15.1

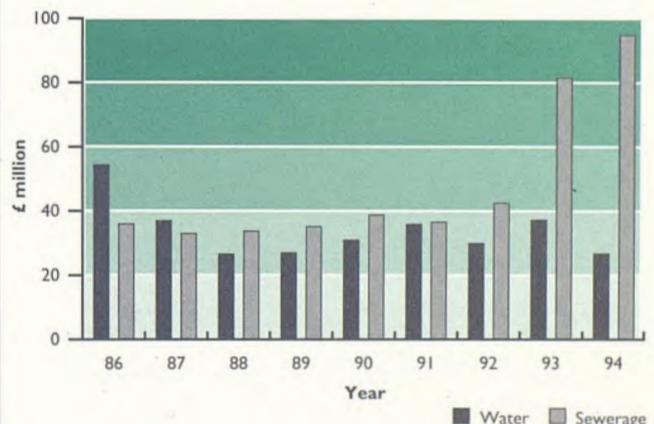


Fig. 15.1 Capital Investment in Water and Sanitary Services 1986 - 1994 (Source: DoE).

The total expenditure by DoE on other 'specific environmental services' in the period 1986-1994 was as follows:

	£ million
Waste disposal/recycling	3.61
Pollution control	1.43
Beach improvements	2.00
Smoke control	5.00
Recovery of CFCs	0.15
EPA	6.98
Total	19.17

The category 'pollution control' above refers to miscellaneous expenditure related to environmental quality matters, e.g., air quality monitoring equipment, Interreg, and the Blue Flag scheme. The total annual expenditure over the period on all of the areas listed above is shown in Fig. 15.2.

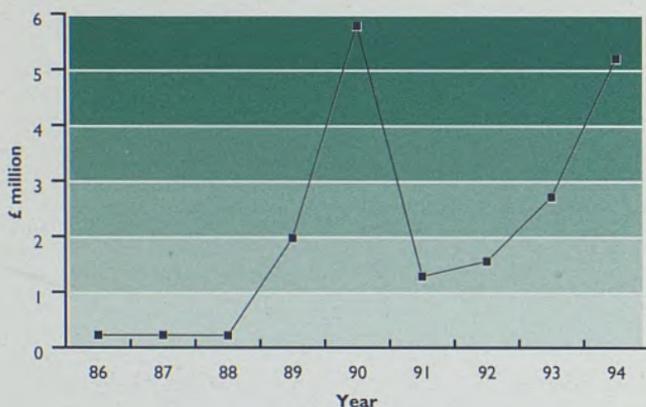


Fig. 15.2 DoE Expenditure on Specific Environmental Services (see text for details) (Source: DoE).

The peak in 1990 is attributable to expenditures of £1 million on beach improvements and of £4 million on smoke control. The increase again in 1994 is mainly due to the EPA budget of £4.40 million in its first full year of operation.

In the period 1986-1994 the total current expenditure by Local Authorities on environmental services was as follows:

	£ million
Public water schemes:	757.19
Public sewerage schemes	388.96
Private installations	8.50
Total	1154.65

Local Authorities' annual expenditure on public water and sewerage schemes during this period is shown in Fig. 15.3. In 1989, a system of 100 per cent grants by the Government to meet the cost of capital works replaced the 'loan and subsidy' funding arrangement. The new arrangements were designed to eliminate circular and wasteful transfers of funds between central Government and Local Authorities and the change was financially neutral where Local Authorities were concerned.

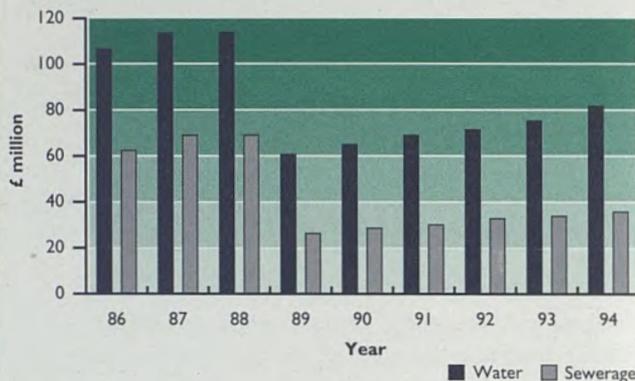
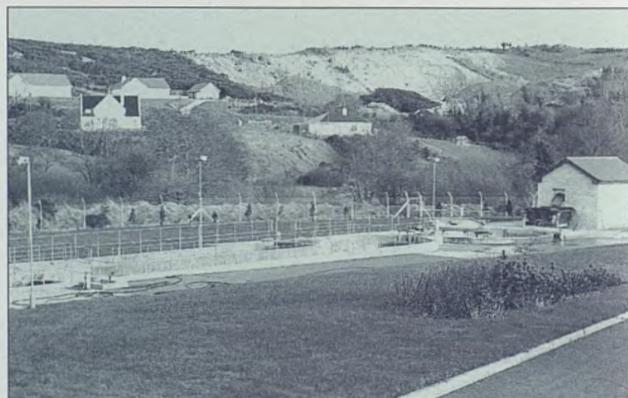


Fig. 15.3 Local Authorities' Current Expenditure on Public Water and Sewerage Schemes 1986 - 1994 (Source: DoE).

It may be noted that although expenditure on drinking water and sewerage services are considered together above, it is the expenditure on sewerage services which is significant in terms of environmental protection *per se*.



In the period 1986-1994 the total expenditure on solid waste disposal and pollution control (which includes miscellaneous related activities of the Local Authorities) was as follows:

	£ million
Solid waste disposal	487.79
Pollution control	35.83

The annual expenditure on these items is shown in Fig. 15.4.

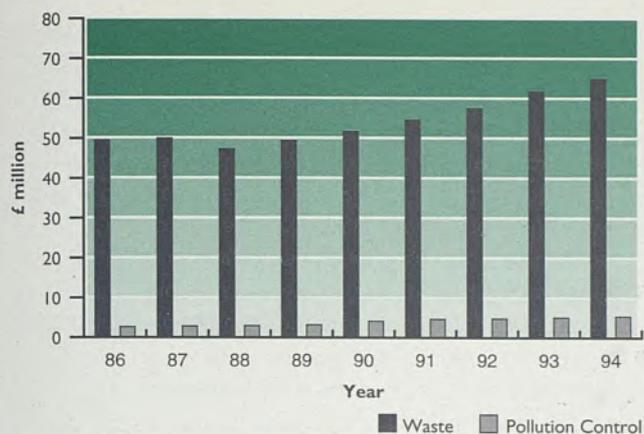


Fig. 15.4 Local Authorities' Expenditure on Waste Disposal and Pollution Control 1986 - 1994 (Source: DoE).

EVALUATION OF EXPENDITURE ON ENVIRONMENTAL INFRASTRUCTURE

The OP for Water, Sanitary and Other Local Services 1989-1993 involved a gross expenditure of £222 million (half of which was ERDF grant assistance). The Programme was designed to contribute to increasing the economic potential, development and structural adjustment in Ireland.

ENVIREG

ENVIREG, a Community initiative under the previous Community Support Framework, was a regional action programme designed to counter the environmental problems that hinder regional development.

Ireland's OP under ENVIREG aimed at augmenting the impact of the Water and Sanitary Services OP and concentrated in particular on reducing untreated sewage discharges in coastal towns with fewer than 100,000 residents. The programme covered the period from November 1990 to December 1993, with expenditure of £31 million.

An evaluation was made of the completed OP, and of expenditure under the ENVIREG Community initiative. The findings on the performance of the 1989-1993 OP were presented in an Annex to the document outlining the Environmental Services 1994-1999 OP (Department of the Environment, 1994b). Aspects of the evaluation are summarised below.

Economic Impact

The evaluation noted that industries accounting for over a third of Ireland's manufacturing output are major users of water and sanitary services. It is likely that investments under the Water and Sanitary Services and ENVIREG OPs have assisted this growth and have reduced or avoided infrastructural constraints. Recent growth in manufacturing industry and employment in such sectors as food, chemicals and pharmaceuticals could not be sustained without increased investment in water supply and in the general infrastructure for environmental protection. Many sewerage schemes have removed the need for planning restrictions due to infrastructural constraints and have thus facilitated new developments and economic growth. However, in most instances it was considered to be too early to assess the impact of advance provision of schemes.

Given the importance of a high quality environment to the tourism sector in terms of both marketing and product development, it was concluded that the expenditure under the OP contributed to the growth of tourism.

It was concluded in the evaluation that while there are undoubtedly direct benefits from increased investment in water and sanitary service schemes, more research would be required to quantify these. This research should consider the impact on the local economies at the project level as well as their significance at national level.

Capacity Indicators

Data show an estimated increase in the national water treatment capacity of around 13 per cent over the 1989-1993 period. There is no comprehensive database, however, on existing water treatment capacity in Ireland and the estimated 13 per cent increase is based on a 1989 survey of capacity by the Institution of Engineers of Ireland and estimation of capacity increases under the OPs by DoE.

Environmental Impact

The evaluation concluded that much of the reduction in serious pollution in Irish rivers and streams in recent decades can be attributed to improvements in waste water treatment facilities. An area of concern is the increase in the levels of slight and moderate pollution of many Irish rivers and streams (see Chapter 9).

The decline in the total number of fish kills was noted in the evaluation, along with the decline in the number of fish kills attributed to sewage. A better assessment of the environmental impact of water and sanitary investments would require further research into the link between river pollution and sewage discharges.

An increase in the number of monitored beaches conforming with EU quality of bathing water standards and receiving the "blue flag" awards was taken in the evaluation to indicate benefits resulting from the investment in waste water services.

The improvement in the water quality at Lough Ennell resulting from the Mullingar sewage treatment scheme was given as an example which highlights the contribution of these schemes to the environment.

Long Term Benefits

Treatment schemes are expected to operate for at least 25 years and collection and distribution systems for 50 years or more. Given this long design life, the initially evident benefits of recently completed schemes must be seen as only a small part of their overall economic impact. Also, a key aspect of environmental investments is prevention of potential economic losses. The damage arising from a lack of investment may take a long time to remedy or may even be irreversible.

PLANNED INVESTMENT IN ENVIRONMENTAL SERVICES 1994-1999

General objectives for environmental investment in Ireland in the period 1994-1999 are as follows:

- to preserve the quality and character of the natural environment;
- to prevent pollution or depletion of natural resources which would inhibit economic growth;
- to remedy existing pollution;
- to provide an efficient environmental infrastructure to support expanded economic activity;
- to achieve compliance with European waste water and drinking water standards.

Public investment in environmental infrastructure, inclusive of Cohesion and Structural Funds' assistance and national resources, is planned to reach at least £650 million in the period 1994-1999 (an average of £2 million a week).

At the end of 1994, the first full year of Cohesion funding, eight water and fourteen sewerage projects were in the construction phase. Cumulative expenditure at December 1994, totalled £82 million, of which £69.7 million was in EU aid (Department of the Environment, 1995a).

A detailed review of all water and sanitary services schemes at the various planning stages was carried out to determine priorities for the period 1994-1999. The review sought to identify services needed for the following (Department of the Environment, 1994b):

- meeting the new obligations arising under Directive 91/271/EEC concerning urban waste water treatment;
- meeting other statutory requirements;
- meeting existing and future economic development needs;
- dealing with serious pollution;
- dealing with serious urban flooding problems;
- meeting health and safety concerns;
- meeting water quality and supply requirements.

Investment is proposed for water supply and wastewater collection, treatment and disposal, with the following breakdown by source of funding:

Source	£ million (approx.)
Exchequer co-financed by Cohesion Fund	489
Exchequer co-financed by Structural Funds	61
Exchequer only	54
Other sources (including Local Authorities)	48
Total	652

Projects are grant aided under the Cohesion Fund at a rate of up to 85 per cent. Capital investment will be increased by extension of the principle of user capital contributions in line with the polluter pays principle. Private funding will also be sought to complement the investment programme by the public sector (Department of the Environment, 1994b). The total planned investment of £652 million includes an amount of £101.6 million for the OP for Environmental Services 1994-1999, details of which are given in the box below.

Operational Programme for Environmental Services 1994-1999

The Operational Programme (OP) for Environmental Services 1994-1999 has been prepared in accordance with the CSF for Ireland and based on the National Development Plan. It will be implemented with assistance from the European Regional Development Fund (ERDF). The OP covers direct investment in environmental services and research and development. It provides for an investment of £101.6 million over the period. There are five main areas for investment as follows:

	£ million
Water and sewerage services	58.0
Waste management	30.5
Coastal protection	5.1
Environmental monitoring R&D	5.1
Technical assistance	2.9
Total	101.6

Of the £58 million for water and sewerage services the amount for waste water treatment is £32 million. The EU is providing £63 million, in ERDF aid, of the total sum of £101.6 million.

ECONOMIC INSTRUMENTS FOR ENVIRONMENTAL PROTECTION

Several economic instruments for environmental protection, such as taxes, charges and subsidies, have been in operation in Ireland for some time. Use of such instruments in general, however, is not very widespread. There may be increased usage in the future, resulting from wider implementation of the polluter pays principle, from compliance with requirements that some environmental services be self-financing as well as from growing recognition of the potential role of incentives. This role has been identified in the Fifth Environmental Action Programme.

The Organisation for Economic Co-operation and Development (OECD) has defined a number of categories of economic instruments (OECD, 1989), which include charges (i.e., pollution taxes, raised where there is no treatment or service), user charges, product charges, administrative charges, tax differentiation, subsidies, deposit-refund schemes and other instruments including enforcement incentives. Such instruments are currently under review by the ESRI. Some examples of the application of these in Ireland are reviewed briefly below.

Charges

Three per cent of its market value can be levied on a derelict property in an urban area. Some £45,000 was levied in 1993.

User Charges

In most areas, households pay charges to the Local Authority to provide partial cover of costs for water and sewerage services and for solid waste removal. Non-domestic premises pay for solid waste removal; charges are volume-related in some areas. Industrial effluent discharged to municipal waste water treatment plants is charged in some areas. Proposals for a more widespread and formal charging system were outlined by the ESRI (Scott and Lawlor, 1994).

Product Charges

The category of product charges relates to items which pollute in the production or consumption phase. A study by the ESRI considered the question of a carbon tax (Fitzgerald and McCoy, 1992). The Government has indicated that progress on energy conservation must be made through a combination of incentives and charges. The Government is also committed to contributing to the preparation of a European carbon/energy taxation policy.

Administrative Charges

Administrative charges include licensing and monitoring fees. The fees for an IPC licence, payable to the EPA, are designed to recover the costs to the Agency of processing applications for licences and reviews of licences or revised licences. The level of fees reflects the need to maintain equity between different sectors and to avoid placing an undue burden on small-sized enterprises.

A monitoring charge, covering the costs of monitoring emissions is being levied under the IPC system, operated by the EPA.

Tax Differentiation

A lower level of excise tax is charged on unleaded petrol compared to that on leaded petrol. Annual average sales of unleaded petrol as a percentage of total petrol sales have risen from seven per cent in 1989 to 49 per cent in 1994. Monthly average sales of unleaded reached just over 58 per cent by the autumn of 1995. Annual average sales are shown in Fig. 15.5. The trend of decreasing air lead levels in Dublin corresponding to the increased use of unleaded petrol has been shown in Chapter 8.

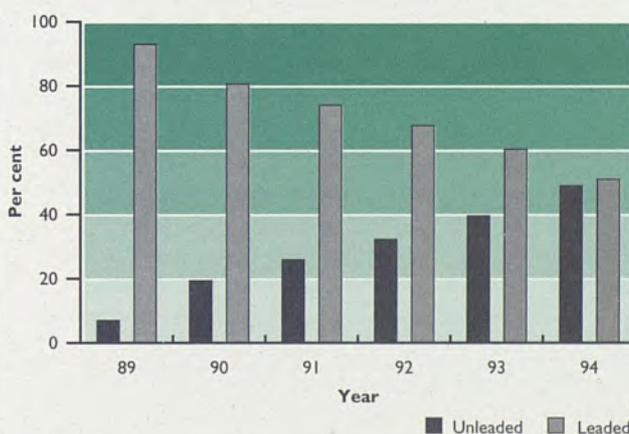


Fig. 15.5 Annual Unleaded Petrol Sales and Leaded Petrol Sales as a Percentage of Total Petrol Sales 1989 - 1994 (Source: DoE).

The excise taxes on energy are high relative to those in many other countries. Excise tax on vehicles and Vehicle Registration Tax are graded according to cubic capacity of the engine.

Special rates of exemption and tax write-offs are provided for urban renewal in certain designated areas and seaside resorts. In Dublin, further incentives are available for the Custom House Docks area. There is income tax relief for owners or occupiers of historic buildings who provide reasonable access to the public.

Subsidies

Subsidies include grants, low interest loans and tax allowances. Subsidies are given to firms to undertake environmental audits, towards industrial education in environmental management and energy use. An important subsidy has been that available in the relevant areas to those who otherwise have difficulty in meeting the additional costs of smokeless fuels. The matter of grants is considered later in this chapter in relation to a number of key economic sectors.

A total of £500,000 was awarded to 26 recycling projects under the DoE Recycling Grants Scheme in 1994. A total of £400,000 had been awarded in 1993. Grant aid allocated to local authorities for urban renewal in 1994 totalled £1 million (Department of the Environment, 1995a).

Subsidies to agriculture include (a) direct cash payments, e.g., under the Control of Farmyard Pollution Scheme (for pollution control, basic winter housing and forage storage), the Farm Improvement Programme, the new REPS scheme (see below), and the scheme for the protection of the corncrake, and (b) education, mainly through Teagasc (the Agriculture and Food Development Authority).

Stocking density limits were introduced to encourage extensive farming. New stock density limits on the number of animals which can qualify for premia have been introduced as part of the reform of the CAP. Payments are being progressively restricted as the maximum stocking density limits are reduced in even amounts from 3.5 livestock units (LU) per hectare in 1993 to 2.0 LU per hectare in 1996. An additional top up premium is also payable on suckler cows and male cattle to producers whose stocking density is less than 1.4 LU per hectare.

Deposit-refund Systems

Deposit-refund schemes are not well developed but to date have included deposit-refund systems for cans, for example, on some offshore islands and an indirect refund on returned supermarket plastic bags, the refund generally being given to worthy causes such as charities. A supermarket chain

operates a "lucky can" scheme where people returning aluminium cans get an opportunity to win a prize (Department of the Environment, 1995b).

Market Creation

Included in the market creation category are emissions trading, and market intervention. Emissions trading is considered to run contrary to IPC as currently practised. As one example of market intervention, many Government Departments and agencies purchase recycled paper.

Enforcement Incentives and Liability Insurance

The enforcement incentives category includes non-compliance fees and performance bonds. It also includes fines for non-compliance, and damages which are sometimes decided by the courts.

Mining companies' expenditure on site rehabilitation carried out after the cessation of trading cannot at present be claimed against profits generated during mining operations. Neither are the costs of building up cash funds and insurance bonds/sureties, which are required by planning or other necessary permissions, allowed against profits for tax purposes. It has been recommended that both should be allowable (National Minerals Policy Review Group, 1995). The question of bonds of this type is relevant also to other activities, for example, hazardous waste facilities.

Anomalies

Overall, the main anomalies include many instances where the costs of environmental degradation are borne by persons other than those responsible for causing the damage. Other anomalies include low use of charges, even for cost recovery. Labour taxes may hinder labour-intensive environmental activities such as recycling, energy conservation, maintenance and repair, while capital allowances for energy-consuming equipment and vehicles may encourage energy use and emissions. There are some further examples of anomalies: the VAT rate on energy conservation materials is higher than on energy *per se*; urban parking is largely under-priced; and there has been a tax bias in favour of new construction rather than refurbishment, which recent changes have attempted to redress.

KEY SECTORS

Industry

The importance of the manufacturing sector is reflected in its 35 per cent share of GDP in 1994 (CSO, 1995). Current employment levels amount to almost 200,000 persons, or 20 per cent of the total number of persons at work in Ireland. The spin-off from the spread of manufacturing industry in the economy helps to support approximately nine jobs in down-stream services for every 10 jobs in the manufacturing sector, and hence manufacturing supports a total of 380,000 jobs in Ireland (O' Malley, 1993).

The Irish Economy Expenditure Survey, conducted by Forfas (the Policy and Advisory Board for Industrial Development in Ireland), shows that industry spends £15 billion per annum, mainly on Irish raw materials (£6.5 billion), labour (£3.8 billion) and services (£3.8 billion).

It is difficult to pinpoint what is purely environmental expenditure in overall capital costs. Consequently the amount of expenditure on environment related activities and controls by industry is difficult to determine. Investment in buildings, machinery and equipment of over £280 million in 1994 and £320 million in 1993 was given grant support by Forbairt and IDA Ireland, the agencies which have responsibilities for promoting industry from indigenous and overseas sources respectively. The total of such investment (including non grant-aided) by all manufacturing companies is higher than the above figures. The proportion of these amounts spent on environmental measures is not known. It is known, however, that investment in food companies supported by FEOGA (European Agriculture Guidance and Guarantee Fund) includes an element, amounting to between eight and ten per cent, which is exclusively focused on measures for pollution prevention and control.

Clearly there is a broad range of requirements for environmental expenditure depending on the type of industry involved. The chemical and pharmaceutical sectors have particularly high requirements (with one recent development in particular expending on environmental facilities 25 per cent of its total investment of £200 million). For industry generally, as noted earlier, it has been tentatively estimated that manufacturing companies will invest upwards of £500 million during this decade in environmental protection facilities.

The implementation of IPC licensing by the EPA requires the use by industry of best available technology not entailing excessive costs (BATNEEC) in which the emphasis is placed on pollution prevention techniques, including cleaner technologies and waste minimisation, rather than relying

solely on end-of-pipe treatment. Besides the costs incurred by industry in the preparation of applications and in applying for IPC licences, increased expenditure by industry in providing environmental measures in meeting BATNEEC is anticipated. The introduction of IPC in 1994 has marked the start of a new culture of reducing waste and preventing and controlling pollution by industry. Already, in addition to mandatory requirements, more and more Irish companies are voluntarily engaging in activities to improve their environmental performance.

It may be noted that IPC and BATNEEC requirements will apply to other sectors also, viz., intensive agricultural units for pigs and poultry, and also to the energy sector.

Agriculture

Agriculture is one of the most important indigenous industries in the country. In 1994, it accounted for 8.8 per cent of GDP and about 12 per cent of employment.

Several problems were addressed under the previous OP for the Control of Farmyard Pollution 1989-1993, supported by the Structural Funds. Improving the environment is one of the priority areas selected for development in the OP for Agriculture, Rural Development and Forestry 1994-1999. Under this OP grant aid for pollution works has also been made available under the Farm Improvement Programme. A further important measure is the agri-environment scheme REPS (see Chapter 14) introduced under the CAP reform agreement and co-financed from the Guarantee side of the EAGGF.

The level of investment in pollution control on farms is generally related to developments in farm income. The total capital investment in farm structures involving pollution control in the period 1985-1993 is shown in Fig. 15.6

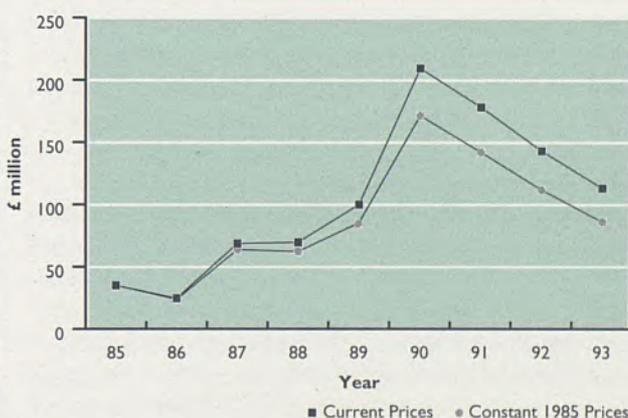


Fig. 15.6 Capital Investment in Farm Structures for Pollution Control 1985-1993 (a) Current Prices, and (b) Constant 1985 Prices (Source: CSO).

Operational Programme for the Control of Farmyard Pollution 1989-1993

This was an OP under the CSF for Ireland 1989-1993. The programme provided grant funding to individual farms for investment in on-farm pollution control measures, in particular to provide farm waste storage facilities, basic winter housing for cattle and sheep, and fodder storage.

Grant aid was paid to a total of 20,000 schemes for which the total cost was £193 million and the total grant aid paid was £91.7 million. The greatest numbers of schemes were in counties Mayo (3,200), Galway (2,927), Donegal (1,733), Cork (1,294), Roscommon (1,164) and Monaghan (1,093).

An evaluation of the OP (Fitzpatrick Associates, 1992) found that the up-take, in terms of approvals, exceeded expectations. It concluded that there was evidence of success in reducing farmyard pollution. On participating farms, the deficit in waste storage facilities was reduced from 57 per cent to 12 per cent on completion. There was a gross increase of 57 per cent in animal housing places and an increase of 26 per cent in silage storage capacity on participating farms. The overall conclusions were that this OP was an appropriate, effective and economically justifiable usage of EU Structural Funds, and that future programme content should include a broader range of anti-pollution and environmentally friendly farming measures. The latter recommendation has in general been implemented in the subsequent REPS scheme (see below).

Farm Improvement Programme - 1986-1993

Total expenditure on provision of improving agricultural operations under the programme in the period 1986-1993 was £360 million of which £120 million was grant aid. Approximately 80 per cent was spent on capital grants for pollution control measures.

Programme for Western Development

Under the programme a scheme of investment for basic winter housing, forage storage and pollution control operated from July 1988 to August 1989. Grant aid of £8.901 million was paid.

Environmentally Sensitive Areas

The scope of the Environmentally Sensitive Areas scheme was limited to the Slieve Bloom Mountains and Slyne Head. The uptake of the scheme was limited - only £25,000 was dispensed over the period of the scheme, which has been subsumed into the agri-environment scheme introduced under the CAP reform agreement.

Operational Programme for Agriculture, Rural Development and Forestry 1994-1999

The promotion of farming in harmony with the environment is one of the central objectives of the OP for Agriculture, Rural Development and Forestry 1994-1999.

The total capital investment of £450 million (of which £195 million is co-financed by the EU and the national exchequer) has been allocated for the following programmes:

Farm Improvement Programme: includes housing facilities for livestock, and storage facilities for fodder, animal waste and effluent ;

Improvement of Animal Welfare Standards: improved housing facilities for cattle, pigs and poultry;

Improvement of Dairy Hygiene Standards: involving various provisions, including improvement of water quality at farm level;

Control of Farm Pollution; a scheme of grant aid for (a) farm waste storage, associated facilities and disposal equipment, (b) winter housing for cattle and sheep and associated facilities, (c) fodder storage and associated developments, and (d) farm roads, water supplies and screening belts.

Agri-Environment Research

Environmental research within Teagasc is based almost exclusively at its Research and Development Centre at Johnstown Castle, Wexford. The Centre's estimated expenditure (total) has risen from £100,000 in 1985 to £1,200,000 in 1994 (Fig. 15.7). Support from EU, Department of Agriculture, Food and Forestry, and the International Fund for Ireland in that period has risen from £60,000 in 1989 to £393,000 in 1994.

Research in sustainable agricultural development is provided for under the 1994-1999 OP. This will involve the development of viable nutrient and waste management strategies. These strategies will be designed in such a way that the impact on the environment of agriculture and other developments located in rural areas will be minimised. It will also involve the development of strategies for the enhancement of landscapes in rural areas and the ecological management of 'set-aside' areas, including habitat re-establishment studies.

Study on Farm Waste Control

A 1988 study on the control of farm wastes was undertaken by advisors on 650 farms from the total of 124,000 holdings having more than 10 LU. Results showed that the average cost, per farm, of providing the required waste control facilities on dairy farms was over £8,000 in disadvantaged areas and over £9,000 in non-disadvantaged areas. It was about £5,000 on dry stock farms for both areas (Regan, 1988). Calculations showed, by extrapolation, that the total national cost of upgrading waste control facilities on farms would be approximately £300 million, with an urgent need for immediate action on 12 per cent of farms at a cost of over £100 million.

Agri-Environment Education and Training

A sustained advisory and training programme over five years at a cost of about £2 million per annum was deemed essential.

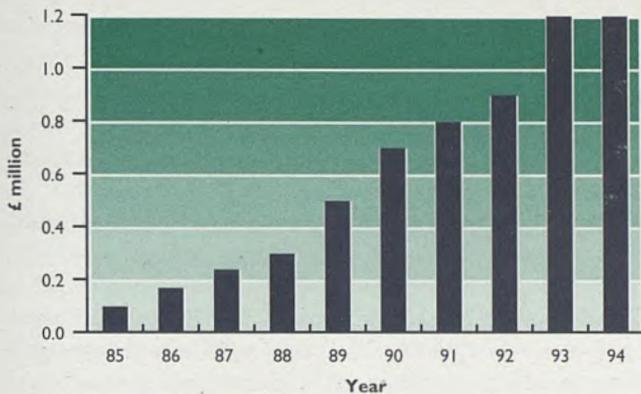


Fig. 15.7 Expenditure on Environmental Research 1985-1994 by Teagasc (Johnstown Castle).

Good results were soon evident from the sustained effort by advisors in training farmers. A five-year advisory programme (1989-1993) was initiated by Teagasc with specific targets to reduce quantified farm pollution problems and defects around the farmyard.

Rural Environment Protection Scheme (REPS)

The REPS scheme, which is described in Chapter 14, has a budget of £230 million and will encompass pollution control and reduced risk from fertiliser (including manures) and pesticide use on farms. In addition to encouraging farmers to follow a comprehensive agri-environmental plan, there are specific measures to resolve overgrazing problems and to conserve designated Natural Heritage Area (NHA) sites.

Organic Farming

Organic farming aims at producing food of optimum quality in a manner beneficial to the environment and wildlife. There are approximately 400 organic farms in the country. Payments are available under the REPS to farmers who are already in or wish to convert to organic farming.

In addition, a sub-measure of the OP for Agriculture, Rural Development and Forestry to aid the promotion, marketing and distribution of organic produce was launched by the Minister of State at the Department of Agriculture Food and Forestry in July 1995. The objectives of the scheme are to ensure a regular supply of high quality organic produce to the market by means of the following:

- (i) the development of organic operations through aid for on-site structural works, machinery and other

equipment (e.g., produce stores, grading, packing, storing, drying and distribution facilities);

- (ii) marketing and promotion ventures/projects in support of organic farming.

Under section (i) of the scheme, grant aid will be at a rate of 50 per cent of the approved investment, subject to a maximum investment of £70,000. Under section (ii), grant aid will be at the rate of 70 per cent of the approved investment, subject to a maximum investment of £20,000. Grant aid will be paid only to recognised bodies as defined in the scheme.

Tourism

Tourism is one of Ireland's most important foreign currency earners. Between 1984 and 1994 there has been a massive increase in tourism activity. Over 3.7 million overseas tourists visited Ireland in 1994 compared with 1.7 million in 1984. Tourism supports 94,000 jobs and plays an important role in supporting employment in rural communities. Tourism has been identified by Government as a key growth sector.

Revenue from overseas tourists reached £1.5 billion in 1994. Money spent by Irish residents (including business and other trips) amounted to £0.681 billion. Hence the total tourism revenues passed £2 billion (which is a rise of 58 per cent over the five years to 1994) and tourism revenue accounted for 7.0 per cent of GNP. In 1994, about 185,000 overseas visitors engaged in angling and they contributed over £69 million to the economy. In 1994 also 174,000 tourists played some golf while in Ireland contributing £73 million to the economy.

The OP for Tourism 1989-1993 envisaged expenditure totalling £147 million from the ERDF and the ESF. The sub-programme on public and similar bodies was dominated by two measures - inland waterways and culture and heritage. Concerning the latter, the recent CSF evaluation noted that the biggest expenditure has been on visitor and interpretative centres, theme towns and national parks and that a striking feature of the measure was the number and spread of projects assisted. The £30.2 million spent to date has gone on 105 separate projects in 24 counties (Fitzgerald and Keegan, 1995).

The decision has been made not to continue with the construction of two visitor centres, one in the Burren and the other in the Wicklow Mountains. The development of the two centres had been the subject of controversy and dispute over a lengthy period. The overall financial implications of the work on the centres remain to be fully determined.

The OP for Tourism 1994-1999 sets a target of creating 35,000 additional jobs supported by tourism by 1999. This is set to be achieved through growth of 56 per cent in foreign exchange earnings over the same period. In 1994, over three-quarters of overseas tourism revenues (excluding carrier receipts) accrued outside Dublin. Tourism has proven potential to contribute to developing areas along the western seaboard. The issue of sustainable tourism development is addressed in Chapter 16.

Energy

The Irish Energy Centre, hosted by Forbairt, has been established by the Department of Transport, Energy and Communications with assistance from EU Structural Funds. It will co-ordinate and implement the national energy conservation programme. The main elements of the Centre's programme will include the provision of the following economic measures:

- grant aid to undertake energy audits;
- aid, on a selective basis, for investments in energy efficiency;
- a series of technical advice measures, such as good practice guides on specific issues, with seminar backup, and the establishment of two regional energy offices, one concentrating on renewables and the other on the development of energy training packages;
- a series of energy awareness and promotional campaigns.

Over the period 1994-1999 a total of £21 million will be invested by the Department of Transport, Energy and Communications and the Irish Energy Centre in energy conservation activities.

The Energy Audit Grant Scheme will provide grant assistance to organisations engaging independent consultant auditors to carry out site energy audits and surveys. A grant of up to 40 per cent of the cost, excluding VAT, is available subject to a maximum of £5,000.

Activities under the EU Thermie Programme include the funding of projects that can further the energy efficiency objective. A network of housing developers has been established in a project on housing with low energy requirements and giving rise to low carbon dioxide (CO₂) emissions. The Irish contribution will be the construction of 58 energy-efficient houses at various locations, and these are expected to show a saving of 30 to 50 per cent on energy costs compared with their standard counterparts, typically worth up to £200 to £300 per annum per household (Department of the Environment, 1994a).

The CO₂ Abatement Strategy for Ireland (Department of the Environment, 1993a) notes that energy policy can have

a major impact on limiting CO₂ emissions. In addressing fiscal measures, the report states that in Ireland the high level of energy taxation is presumed to result in a more efficient use of energy than would otherwise be the case. However, Ireland is already relatively energy intensive, as judged from the energy to GDP ratio.

The results of the Alternative Energy Requirement (AER) scheme were announced in March 1995. This was a Government initiative to secure a target of 75 MW of additional installed capacity from renewable energy sources. Indicative targets were set in four technology categories when the scheme was announced, and all are represented in 34 proposals to be offered power purchase agreements by the ESB. The AER scheme was based on the offer of a power purchase agreement for up to 15 years and an initial price of up to 4p per unit of electricity generated. Although the scheme provided an option to bid for grant aid, the 75 MW target was exceeded without the need to resort to the grant support. The initiative, however, will incur additional costs of the order of £70 million over the 15 years.

The successful projects include ten wind farms, ten small scale hydro plants, eight combined heat and power (CHP) schemes and six other projects (mainly landfill gas). Their development will increase the electricity generated by independent producers from 90 MW in 1994 to approximately 200 MW by 1997. Assuming that all the projects proceed, alternative energy will supply about ten per cent of total electricity needs.

Details of a competition to secure one plant of up to 30 MW using biomass as a fuel were announced in July 1995. Grant assistance of up to £7.5 million will be provided under the Economic Infrastructure Operational Programme. A general review of strategy in relation to the development of all renewable energy sources is proceeding in parallel with this competition. The results of this review will be used as a basis for determining the setting of future targets for alternative sources.

The total cost of a windfarm development at Bellacorick, County Mayo, is £7.1 million, of which 55 per cent has been made available under the EU Valoren Programme

Transport

Transport plays a critical role in underwriting social and economic development and has been widely recognised as a central element in the diffusion of benefits and in the attainment of convergence throughout the EU. Ireland faces two principal transport disadvantages in trading with its European partners. The first is peripherality: time and distance to major continental markets with consequent penalties in terms of access to market intelligence, reliability

of supply networks and other factors. The second major disadvantage stems from the deficient state of the internal transport network. It has been stated (GREEN 2000 Advisory Group, 1993) that a proper recognition of the contribution of transport to the national economy is fundamental to addressing the environmental consequences of transport use and thus achieving a sustainable transport policy. Changes in the balance and mode of operation of economic sectors have increased the demand for transport, e.g., an increased emphasis on constant regular deliveries of raw materials and components to manufacturing industry.

The Operational Programme on Peripherality (OPP) covered investment on road, rail, port and airport infrastructure and facilities involving a total estimated expenditure of £875 million over the period 1989-1993. The principal economic objective of the OPP was to reduce the transport cost differential for Irish exporters to mainland Europe as compared with the transport cost of exporters trading directly on the European continent.

The review of the CSF 1989-1993 undertaken by the ESRI concluded that bottle-necks still remain in the transport system and new projects having a considerable rate of return remain available. In particular it expressed the view that investment in major road improvements should continue as the top priority, accounting for the bulk of all funds under any future transport infrastructure programme. The transport development strategy for the period to the end of the decade will continue to provide for significant investment in roads but will also provide for a change in emphasis with a very much increased level of investment in the national railway network and public transport system in Dublin so as to provide high quality services which will attract increased market share and reduce pressure on road space and on the environment. This will be complemented by traffic management measures in urban areas and increased support for rural road networks.

The transport sector is heavily taxed in Ireland, contributing approximately £1.5 billion per annum in direct taxation equal to five per cent approximately of GNP. This high level of taxation largely reflects pressures on the general revenue side rather than any direct use of taxation as a tool to manage transport demand. However, there are several aspects to taxation and public finance policy which are relevant to the environmental impact of transport:

- a graduated road tax regime applies, related to engine capacity, with larger cars being subject to higher levels of tax;
- there is a tax incentive in favour of unleaded petrol;
- an annual exchequer subvention of approximately £100 million is paid to Coras Iompair Eireann (CIE) to support the provision of public transport services.

A further important environmental aspect of transport is the use of economic instruments which affect vehicle ownership and use, as discussed earlier. A recent budgetary measure encourages the taking of older cars off the road. Details relating to the use of unleaded petrol have been given above.

It is difficult to place a monetary value on the environmental cost of transport. A recent review noted that there seems to be an agreement in industrialised countries generally that such costs are equivalent to several per cent of GDP but estimates are subject to very great uncertainty. A recent UK estimate places the cost in money terms at between 2 per cent and 3.5 per cent of GDP and this was mainly accounted for by road transport. Environmental damage can take many forms, and the UK study concluded that assigning a monetary value to some of the forms of environmental damage is not at present possible, and may never be possible (Royal Commission on Environmental Pollution, 1994).

ECONOMIC BENEFITS

In 1993, the GREEN 2000 Advisory Group estimated that, excluding farming, 155,000 people were in direct employment which is significantly dependent on high environmental quality. There is a clear linkage between economic performance and environmental quality, though, again, this has not so far been accurately quantified.

A conservative estimate, produced by the University College Dublin Environmental Institute, on the basis of 1987 figures, suggested that 2.2 per cent of GDP in that year was attributable to a high quality environment. Importantly, this was concentrated in the high growth sectors - high technology industry, food processing and tourism - indicating that further growth prospects could depend very significantly on the maintenance of a high quality environment.

The Report of the Industrial Policy Review Group, *A Time for Change: Industrial Policy for the 1990s*, recognised Ireland's 'green' image as something which would bring competitive advantage provided it was preserved and enhanced. The Group concluded that maintaining a level of environmental quality at the top of the European league should be the aim, and this should be a source of advantage in the agriculture and food processing sectors.

Other economic benefits deriving from better management of the environment and natural resources include the cost savings that can result from greater efficiencies in the use of materials and energy. The case of energy efficient housing was mentioned above.

INFORMATION GAPS

More definitive information is needed on the expenditure on the environment by industry and by the other economic sectors. This can contribute to refining the overall estimate of expenditure on the environment in Ireland. There is a need to develop and refine existing data collection and storage in order to have a comprehensive database on the existing water supply infrastructure and, in particular, on all aspects of the existing sewerage infrastructure in Ireland. Research is needed on the environmental benefits of investment in water and sanitary services.

In relation to determining environmental benefits, there remains considerable uncertainty as to how various benefits of environmental protection and improvement can be quantified in economic terms.

It would be desirable to have improved methods of Green Accounting (i.e., accounting methods which take into consideration positive or negative environmental impacts and degradation of natural resources), because of flaws which exist in national accounting as it relates to the environment. Existing national accounting systems have the following flaws: national income may be overvalued owing to the inclusion of mitigating expenditures (e.g., the need for double glazing because of noise from transport); they ignore the negative impact on economic welfare of environmental damage; and they ignore degradation or depreciation of natural assets (Scott, 1995). As noted previously, further studies are under way on economic instruments in Ireland. Overall, there is a need to quantify the relationship between economic performance and environmental quality as part of the process of achieving sustainable development.

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BROWN THOMAS

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SUSTAINABILITY: ISSUES AND INDICATORS

INTRODUCTION

Sustainable development has been referred to at various points in this report. Likewise the concept of indicators was introduced briefly in Chapter 3, and is also considered in other chapters. These matters, however, form a particular focus for the present chapter, in which the objective is to draw together the key issues arising from this assessment of the state of Ireland's environment.

The development of a comprehensive set of environmental indicators for Ireland is a task which will require special focus over the coming years. It is hoped that the publication of this report will give an impetus to that process in providing an overview of the relevant issues.

Sustainability

The publication of the Report of the World Commission on Environment and Development in 1987 (the Brundtland Report) provided the first real impetus to the concept of sustainable development which it defined as follows:

'sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.'

The literature on sustainable development defines two broad approaches. 'Weak sustainability' means an indifference to the form in which the capital stock is passed on to succeeding generations. The environment is simply one form of natural capital. 'Strong sustainability' requires the protection of critical natural capital at least, and is based *inter alia* on the view that degradation of the environment poses the main threat to the well-being of future generations.

In 1992 the United Nations Conference on Environment and Development (UNCED), the Rio Earth Summit, adopted a set of principles to guide future development. These *inter alia* reiterated that development today must not undermine the development and environmental needs of future generations, and that sustainable development requires that environmental protection be an integral part of the development process, rather than be considered in isolation from it. The principles also include the elimination of unsustainable patterns of production and consumption, better scientific understanding of the problems and a sharing of knowledge and innovative technologies to achieve sustainability.

As noted in Chapter 14, the Earth Summit also produced a programme for action on sustainable development into the next century: Agenda 21. This detailed programme is in four sections as follows:

- I Social and Economic Dimensions;
- II Conservation and Management of Resources;
- III Strengthening the Role of Major Groups;
- IV Means of Implementation.

Sustainable development is, of course, central to the Fifth European Action Programme on the Environment, which is titled: *Towards Sustainability. A European Community programme of policy and action in relation to the environment and sustainable development*. The programme identified target sectors and issues of particular seriousness which have a Community-wide dimension (Chapter 14).

Sustainable development aims at improving the quality of life while at the same time conserving the natural resources upon which development ultimately depends. It seeks an economically and ecologically viable way forward, which will be capable of operating within the carrying capacity of the environment. It has been stated that sustainable economic development must seek to break the link between increased production and increasing consumption of environmental resources (Department of the Environment, 1995).

Sustainable economic development is dependent upon striking a balance between resource use and the depletion of such resources. Non-renewable resources can be defined as those which are barely renewed by nature if at all, e.g., minerals and fossil fuels. Renewable resources are those which are renewed over a relatively short period by physical, chemical and/or biological processes, e.g., forests and food.

Indicators

Interest in sustainable development and public concern regarding environmental threats have stimulated Governments to re-examine their capacities to assess and monitor the state of the environment, and also their abilities to detect changing conditions and trends. There is increasing interest in the measurement of environmental performance and in evaluating how well Governments are doing in their efforts to implement their domestic environmental policies and to meet international commitments. Environmental indicators are increasingly seen as one of the tools necessary for helping to chart and track the course towards a sustainable future (OECD, 1994).

Environmental Indicators

An indicator can be defined as a parameter, or a value derived from parameters, which provides information about a phenomenon. Indicators reduce the number of parameters which normally would be required to give an "exact" presentation of a situation. They simplify the communication process by which the results of measurement are provided to the user.

Three major purposes of indicator development are reflected in the three main activities of the work programme of the OECD Group on the State of the Environment:

- indicators for the measurement of environmental performance (activity 1);
- indicators for the integration of environmental concerns in sectoral policies (activity 2);
- indicators for the integration of environmental concerns into economic policies more generally, mainly through environmental accounting (activity 3).

The following three principles are to be considered when using environmental indicators:

- indicators provide only one tool and need to be complemented by other information;
- indicators must be reported and interpreted in the appropriate context;
- there is no single method of standardisation for the comparison of environmental variables across countries.

(Source: OECD, 1994)

A number of different conceptual frameworks have been produced allowing for the identification and development of environmental indicators. As noted previously, at the international level the OECD uses the Pressure-State-Response (PSR) framework. This describes the concept where human activities exert *pressures* on the environment. These pressures result in a change in the quality and quantity of natural resources and a change in the *state* of the environment. Society then *responds* to these changes through environmental, general economic and sectoral policies.

The PSR framework thus distinguishes three broad types of indicators:

- indicators of environmental pressures;
- indicators of environmental conditions or state;
- indicators of societal responses.

The OECD Core Set of indicators (developed as part of its activity 1 - see box) are grouped under the PSR framework for the following issues:

- climate change
- ozone layer depletion
- eutrophication
- acidification
- toxic contaminants
- urban environmental quality
- biodiversity/landscape
- waste
- water resources
- forest resources
- fish resources
- soil degradation.

Indicators have been selected by the OECD for each of these issues, and each indicator is characterised also by the availability of data, determining whether it can be used in the short term, medium term or long term. Further elaboration of the biodiversity and landscape indicators has been undertaken recently by the Nordic Group for Environmental Indicators.

Examples of OECD Indicators by Environmental Issue.

Issue: Climate Change.

Pressure Indicators

- Index of greenhouse gas emissions ** (M)
- CO₂ emissions (S)

State Indicators

- Atmospheric concentrations of greenhouse gases ** (S)
- Global mean temperature ** (S)

Response Indicators

- Energy efficiency ** (M/L)
- Energy intensity (S)
- Economic and fiscal instruments (M)

** denotes 'main' indicators

Data availability: (S) short term, (M) medium term, (L) long term

(Source: OECD, 1994)

Examples of OECD Indicators by Environmental Issue.

Issue: Ozone Layer Depletion

Pressure Indicators

- Index of apparent consumption of ozone depleting substances ** (M)
- Apparent consumption of CFCs and halons (S/M)

State Indicators

- Atmospheric concentrations of ozone depleting substances ** (S/M)
- Ground-level UV-B radiation ** (M)

Response Indicators

- CFC recovery rate ** (M)

** denotes 'main' indicators

Data availability: (S) short term, (M) medium term.

(Source: OECD, 1994)

SUSTAINABILITY IN IRELAND

General Considerations

The principle of sustainability is a declared cornerstone of environmental policy in Ireland. Development must be accommodated within the capacity of the environment to support it, without the environment suffering lasting damage or depletion. All major sectoral policies are required to adhere to this principle. In the National Development Plan 1994 - 1999 (NDP) the principle of integrating environmental considerations into the key sectoral areas (the integration principle) has been adopted. It recognises the need to maintain a sound environment as the natural resource base and guarantor of a range of economic activities.

Many issues were outlined in the national report on Ireland, drawn up for the UN Commission on Sustainable Development (Department of the Environment, 1994), and a number of these are summarised briefly below.

As part of the international follow-up to UNCED, Ireland has ratified the following Conventions:

- UN Framework Convention on Climate Change;
- Basel Convention on Control of Transboundary Movements of Hazardous Waste and their Disposal.

Ireland signed the UN Convention on Biological Diversity at UNCED in 1992; arrangements are currently being made to ratify this Convention (Department of the Environment, 1995).

The implementation of the sustainability and integration principles at Government level involves measures being undertaken in various Departments, e.g., on energy conservation, rural environment and habitat protection. There are a number of standing interdepartmental working groups dealing with aspects of environmental policy, e.g., climate change and cleaner energy, and these influence and direct the national approach.

The Environmental Protection Agency (EPA), in carrying out its functions generally, is required to have regard, *inter alia*, to the 'need for a high standard of environmental protection and the need to promote sustainable and environmentally sound development, processes or operations.'

At local government level, the Local Government (Planning and Development) Acts, 1963 to 1993, provide a comprehensive development authorisation procedure involving extensive public participation. Local Agenda 21 is now being addressed by Local Authorities as has been discussed in Chapter 14.

The national report to the Commission on Sustainable Development also noted that shared responsibility for the environment is encouraged and facilitated by the incorporation into environmental legislation of extensive consultation and reporting arrangements and by the continued development of information systems. There are now extensive rights of access to environmental information following the introduction of the Access to Information on the Environment Regulations, 1993.

Responsibility for the environment is now expected to be shared by all sections of society. This is appreciated as an essential complement to regulation of the environment by public authorities. In order to achieve a wide sharing of responsibility, it is necessary that the range of environmental management instruments is broadened. An example of this is the Irish Standard (I.S. 310) for Environmental Management Systems (Chapter 14).

A significant development at the time of preparation of the present report is the decision by the Government to prepare a National Sustainable Development Strategy to be published in 1996. This strategy will carry consideration of the environment into all areas of Government policy; it will also provide a framework within which national environmental and socio-economic objectives can be integrated and made consistent (Department of the Environment, 1995).

A Cabinet Sub-Committee is to take this initiative forward. There is a range of other national initiatives, including:

- the establishment of a joint Oireachtas Committee on Sustainable Development;
- the definition of a new set of sustainable economic development indicators to be used alongside Gross Domestic Product (GDP);
- the formulation of environmental management plans to give public sector leadership in demonstrating best environmental management practice.

The National Economic and Social Forum, established in 1993, is incorporating appropriate environmental considerations in its work on economic issues (Department of the Environment, 1995).

Sustainable Development and the State of the Environment

The present report can help to provide a foundation for the preparation of a sustainable development strategy for Ireland. As noted earlier, Agenda 21 concludes by emphasising the importance of information for decision making. Information for sustainable development must be provided to the people who need it, when they need it, and in forms which they can understand. In this context, Agenda 21 states that indicators need to be produced to show whether or not sustainability is being achieved.

It is accepted that each country must consider what sustainable development means in its own particular context, since each country has its own distinct circumstances. It is necessary to reflect carefully on what is meant both by sustainability and by development. It has been pointed out also (Adriaanse, 1995) that three main elements of sustainable development can be distinguished: economic, social and environmental aspects.

It has been an objective of this report to identify the key issues relating to the environment and natural resources in Ireland, and to help identify ways, such as indicators, in which information can be provided in a meaningful way to guide sustainable development. It is necessary to consider issues both within the country and in the wider regional and global contexts.

ISSUES AND INDICATORS IN IRELAND

Ireland shares the general international concern in relation to climate change and depletion of the ozone layer. The indicators developed at international level for these issues have been given in the boxes above. In relation to the various other issues for which indicators have been developed at international level, clearly some are more important than others in the national context. From the results of this assessment of the state of the environment, a number of key issues are apparent.

Driving Forces

Aspects of the physical and socio-economic background of particular relevance to the environment have been outlined in this report, mainly in Part I. These, in essence, provide the 'driving forces' that give rise to and control the various pressures on the environment. Key issues in this regard include the following:

- continued growth in the urban population;
- continued industrial development;
- increasing energy consumption per capita;
- increasing numbers of motor vehicles;
- changes in agricultural practices, e.g., since the early 1980s, sheep numbers have substantially increased (more than doubled); silage production has approximately doubled; tillage area has reduced significantly;
- afforestation is increasing steadily;
- tourist numbers have doubled since the late 1970s and are continuing to increase;
- aquaculture has developed substantially.

Pressure Issues

Part II of the report outlined the pressures deriving from these and other factors. Key issues include the following:

- chemicals in the environment (e.g., tributyltin);
- transboundary pollution risks (e.g., radioactivity);
- land use changes (pressures on landscapes and on habitats);
- pressures from land drainage and physical impacts from various development projects;
- overgrazing, with impacts on soils and on biodiversity;
- farm wastes;
- over-application of chemical fertilisers on certain soils;
- increasing emissions of nitrogen oxides (NO_x) (transport being the main source);
- increasing emissions of volatile organic compounds (VOC) (transport being the main source);
- increasing emissions of carbon dioxide (CO₂) (mainly in electricity generation);

- accelerated upgrading required of waste water treatment plants, particularly for coastal towns;
- further increases in sewage sludge for disposal;
- increasing quantities of waste;
- existing landfills reaching capacity;
- disposal of toxic and hazardous wastes;
- litter and unauthorised dumping;
- introduction of non-native species;
- climate change scenarios, with consequences in terms of flooding, erosion, and damage to peatlands;
- localised tourist pressures.

In some respects, pressures on the environment have eased; examples include the following:

- unleaded petrol sales have reached 50 per cent of all petrol sales;
- smoke emissions have decreased significantly;
- emissions of sulphur dioxide (SO₂) have decreased;
- there has been improved management of farm wastes (although further improvement is needed).

State Issues

Considerations of the state of the environment are outlined mainly in Part III of the report. In relation to air, there have been some improvements corresponding to the reduced pressures listed above; these are as follows:

- reduction in smoke concentrations in Dublin;
- sulphur dioxide levels have declined;
- ambient levels of lead in air have declined in Dublin.

Further issues relating to air quality include the following:

- nitrogen oxides approaching limit value in Dublin city centre;
- rare exceedances of ground-level ozone population information threshold;
- more information to be gathered on certain parameters [e.g., VOC and fine particulates (PM₁₀)];
- relatively high levels of smoke in centres other than Dublin (e.g., in Cork, prior to the introduction of controls).

In relation to water, improvements have included the following:

- reduced extent of serious pollution of rivers;
- reduction in fish kills in recent years (but not sustained into 1995);
- all designated seawater bathing waters in 1994 in compliance with mandatory standards;
- over half of shellfish waters in the highest quality category;

- declining radiocaesium levels in the Irish Sea;

Several key issues remain, however, in relation to the aquatic environment, both freshwater and marine:

- increased extent of slight, and to a lesser degree, moderate pollution of rivers;
- increasing nitrate levels in rivers (particularly in the south east);
- phosphate enrichment, particularly in rivers of the east and south;
- 38 per cent of lake surface area examined showing moderate to serious eutrophication and, of this, 5 per cent seriously polluted (note: the bulk of the 38 per cent figure is due to the inclusion of two large lakes in the strongly eutrophic category, i.e., Loughs Ree and Derg);
- effects of radioactive contamination from Chernobyl evident in certain lakes;
- collapse of sea trout populations;
- reports of a decline in brown trout stocks;
- severe reductions in char in certain lakes;
- salmon stocks requiring protection measures;
- evidence of deoxygenation in a small number of estuaries/harbours;
- some elevated levels of metals in tidal inlets, but levels are stable or declining;
- problems of litter and the quality of local inflows to coastal areas.

Key issues relating to the state of the terrestrial environment, and noise, include the following:

- progress with urban renewal, but many derelict sites remaining;
- continuing reductions in vehicle and aircraft engine noise; but
- traffic congestion in cities and towns;
- landscape affected by land use changes;
- afforestation, advantages and disadvantages;
- conservation of a number of important peatlands still without protection;
- soil erosion as a result of overgrazing;
- expansion in sources of noise, e.g., in motorised water sports;
- lack of information on the extent of noise nuisance.

Key issues relating to natural heritage, i.e., wildlife and habitat conservation include the following:

- conservation of scarce native woodland;
- designation of Natural Heritage Areas and Special Areas for Conservation for 'Natura 2000';
- the following are in danger of extinction in Ireland: six species of vascular plants; eight species of birds; three fish species; one amphibian species; several other

species of flora and fauna are under varying degrees of threat.

A general issue of relevance to all of the environmental media is that of their carrying capacity for various activities.

Response Issues

Considerations of the societal response to resource depletion and general environmental issues constitute this last part of the present report (Part IV). Examples of responses include the following:

- implementation of the national Environment Action Programme;
- general development and maintenance of environmental infrastructure, including sewage treatment and waste disposal;
- development of a national Sustainable Development Strategy;
- strategies for specific issues, e.g., recycling, CO₂ abatement, cleaner production, landscapes, eutrophication of lakes;
- new and amended environmental legislation;
- development of Local Agenda 21;
- development of integrated strategies for particular areas, e.g., coastal zone;
- implementation of integrated pollution control (IPC) and other licensing;
- smoke control measures (ban on marketing of bituminous fuels in the large cities)
- controls on tributyltin use;
- application of Environmental Impact Assessment;
- environmental auditing and other methodologies;
- overall levels of investment in environmental protection in the public and private sectors;
- agri-environment measures;
- energy conservation measures;
- raising environmental awareness (e.g. ENFO);
- application of economic instruments;
- quantifying the benefits of a clean environment for the economy and for employment;
- increased emphasis on the environment in the education system.

The lists in this and in previous sections are not intended to be exhaustive, but they nevertheless give an indication of the range of issues involved and the topics for which the ongoing development of indicators would be particularly advantageous.

Proposed Indicators

It is apparent from this review that a number of topics feature particularly strongly, and some of these are assessed

in greater detail below. In this regard, it may be noted also that the Environment Policy Research Centre, established within the Economic and Social Research Institute, is undertaking studies to underpin sustainable development policies. The Centre is advising on an appropriate methodology for the definition of sustainable economic development indicators, to be used alongside existing measures of economic activity such as Gross National Product (GNP), and a report is currently being prepared.

Eutrophication

Eutrophication is a widespread environmental problem in Ireland and, therefore, is one for which the selection of indicators is particularly important. As noted earlier, it is one of the key issues identified also at OECD level. The OECD Core Set of indicators for eutrophication are set out in the box below.

OECD Indicators for Eutrophication

Pressure Indicators

- emissions of nitrogen and phosphorus to water and soil ** (L);
- nitrogen from fertiliser use and from livestock (S);
- phosphorus from fertiliser use and livestock (S).

State Indicators

- biochemical oxygen demand/dissolved oxygen, concentration of nitrogen and phosphorus in inland waters ** (S/M) and in marine waters ** (M/L).

Response Indicators

- percentage of population connected to biological and/or chemical sewage treatment plants ** (M/L);
- percentage of population connected to sewage treatment plants (S);
- user charges for waste water treatment (M);
- market share of phosphate-free detergents (S/M).

** denotes 'main' indicators

Data availability: (S) short term, (M) medium term, (L) long term

(Source: OECD, 1994)

In the national context, the indicator system for eutrophication could be developed and refined further to include:

Pressures:

- nutrient addition where weather and soil conditions are unsuitable for spreading slurry or fertilizer;
- nutrients from point sources;

State:

- winter nutrient levels in marine waters;
- trends in nutrient levels in all waters;
- percentage of lake waters in the higher trophic categories;
- percentage of river waters in the slight to moderate pollution categories;
- incidence of excessive macro-algal and planktonic algal development in tidal waters;
- status of pollution-sensitive species;

Response:

- extent of management of all fertiliser and slurry applications on farms;
- extent of nutrient removal from sewage.

Information relating to many of the selected indicators has been summarised in this report, and more detailed information relating to state indicators is contained in the monograph on water quality in Ireland for the 1991 to 1994 period (Bowman *et al.*, in press).

Urban Environment

Much attention is now being paid to the issue of sustainable cities. There are two aspects in particular in relation to environmental considerations of the urban environment. The first is the urban environment itself; the second is the set of pressures which the urban environment places on its wider surroundings, pressures on the quality of air, water, land and soil.

OECD Indicators for Urban Environmental Quality

Pressure Indicators

- urban air emissions: SO_x, NO_x, VOC ** (M/L);
- traffic density
 - urban (M);
 - national (S);
- degree of urbanisation (S/M).

State Indicators

- population exposure to:
 - air pollution ** (L);
 - noise ** (M);
- ambient water conditions in urban areas ** (M/L).

Response Indicators

- green space ** (M/L);
- economic, fiscal and regulatory instruments ** (M);
- expenditures (M).

** denotes 'main' indicators

Data availability: (S) short term, (M) medium term, (L) long term

(Source: OECD, 1994)

In this case also, the indicator system could be developed further in the national context to include the following (with the additional category of 'driving forces' which may be applicable in other areas also):

Driving forces

- growth in the urban population;
- growth in built-up areas;
- population density;
- energy consumption per capita;
- numbers of motor vehicles;
- commuting and transportation use patterns.

Pressures

- smoke emissions;
- ratio of unleaded to leaded petrol sales;
- waste arisings;
- litter.

State

- concentrations of smoke, SO₂, NO_x, lead and ground level-ozone;
- levels of VOC and PM₁₀;
- trends in certain journey times as a measure of congestion;
- numbers and areas of derelict sites;
- numbers of wholly or partially vacant buildings;
- traffic safety.

Response

- scale of urban renewal schemes;
- smoke control measures;
- scale of recycling;
- sustainable cities initiatives;
- public transport upgrading;
- special paths/lanes for cyclists;
- pedestrianisation;
- infrastructure improvements;
- decentralisation.

The foregoing list provides an indication of how the indicator system for the urban environment might be developed further and has concentrated on the urban environment itself rather than on the pressures which it exerts in the wider sphere. Indicators for sustainable cities are now receiving much attention internationally. Several of the indicators listed above are included in a list of 55 urban indicators prepared in an attempt to assess the state of Europe's urban environment (Stanners and Bourdeau, 1995). The indicators were grouped as follows: indicators of urban patterns; indicators of urban flows; and indicators of urban environmental quality.

Waste

The various issues concerning waste have been outlined in Chapter 7. In relation to waste, the OECD notes that indicators of state are not applicable. The OECD Core Set of indicators in respect of pressure and response are outlined in the box below.

OECD Indicators for Waste

Pressure Indicators

- waste generation **
municipal (S);
industrial (S);
nuclear (S);
hazardous (S/M).

Response Indicators

- waste minimisation ** (L);
- recycling rate ** (S/M);
- economic and fiscal instruments, expenditures (M).

** denotes 'main' indicators

Data availability: (S) short term, (M) medium term, (L) long term

(Source: OECD, 1994)

The OECD indicators cover the main essential features of the waste issue. Further indicators to be considered could include the following:

Pressures

- waste generation in agriculture, e.g., organic wastes, plastics;
- commercial waste;
- volumes of sewage sludge.

Response

- percentage recovered;
- percentage disposed of by various means;
- adoption of clean technologies;
- incentives for the use of recyclable materials;
- provision of new waste management, recovery, recycling, treatment and disposal facilities;
- improved controls on litter and unauthorised dumping;
- improved management practices, including waste avoidance or minimisation.

SOME SECTORAL INDICATORS

Issues in relation to the key sectors in the European and national contexts are summarised in Chapter 17. Aspects of certain sectors of relevance in the present context are discussed below.

Agriculture

It is increasingly seen at both national and European Union levels that environmentally sustainable farming is a requirement for the future. Those systems that are not environmentally sustainable will not be economically sustainable, as high quality food production is dependent on a clean environment (Lee, 1995). Organic farming has developed gradually in Ireland over the past twenty years. It represents a sustainable lifestyle for some farmers and supports are available (Chapter 15).

Suggested Sustainability Indicators for Agriculture

- rate of increase/decrease in the river length in the unpolluted category of water quality;
- rate of the loss of phosphorus to water from the various soil types;
- rate of the loss of the gases ammonia and nitrous oxide from agriculture (present losses of 125,000 tonnes N per annum represent an annual loss of over £50 million to farmers);
- the extent of both hill and arable land erosion;
- concentrations of organochlorine pesticide residues in soils;
- levels of heavy metals Cd, Cr, Cu, Hg, Ni, Pb and Zn in soils;
- extent of semi-natural habitats as an integral part of agricultural landscapes.

(Based on Lee, 1995)

OECD work on agri-environmental indicators has concentrated initially on (a) trends of environmental significance and (b) agriculture-environment impacts (Parris, 1994).

Tourism

For its continued success, tourism depends on the quality of the environment. It has been suggested that it is necessary to balance the following five major elements to achieve sustainability in tourism:

- economic;
- tourist satisfaction;
- social;
- cultural;
- environmental.

Indicators are required to measure these different attributes in order to highlight potential areas of concern and priorities for action. Indicators to monitor sustainable travel and tourism development are under consideration by organisations such as the World Tourism and Travel Environment Research Centre (WTTERC) and the European Commission (Eurostat) (Stanners and Bourdeau, 1995) and there are initiatives also at national level.

Transport

In relation to transport, national policy aims at meeting the transportation and mobility needs of society while at the same time moving towards a more sustainable development model.

The specific environmental objectives of this policy are as follows:

- the promotion of public transport;
- improved infrastructure (roads, rail, ports and airports);
- technically cleaner and more efficient vehicles, particularly private cars.

CORE NATIONAL INDICATORS

This assessment of the state of the environment has set out to provide an overview of the main environmental issues which have continued to be of concern or have emerged over the past decade since the first State of the Environment report for Ireland. These issues represent the main areas where there is a tendency away from sustainability in Ireland. The present chapter has reviewed options for indicators of sustainability, and considered the value of particular indicators in an Irish context.

The range of issues and their interactions is such that a broad range of indicators is necessary to deal with them. There is no doubt, however, that certain indicators have a particular value for the way that they integrate a number of aspects of a situation.

In relation to water quality in Ireland, the percentage of river length and of lake surface falling into the categories indicative of eutrophication is clearly the most relevant indicator of state.

For the urban environment, air quality and traffic congestion are particularly relevant.

In relation to waste, indicators giving trends in the generation of all types of waste and in waste minimisation are important.

Two editions of Irish Environmental Statistics have been produced in the past, and have proved to be invaluable sources for the present report and for various other purposes. A further compendium of that type can have its value enhanced by focusing in particular on the available data in respect of identified and emerging environmental indicators.

In the context of a report on the State of the Environment in Ireland, the emphasis herein has been mainly on issues within the country. It is clear, however, that sustainability is a global issue and the development of a full set of sustainability indicators for Ireland will require, *inter alia*, consideration of national consumption and production pattern in the wider international context.

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DISCUSSION AND FUTURE OUTLOOK

INTRODUCTION

This chapter addresses the main sectors that interact with the environment and the main trends and emerging issues that are apparent from the assessments in previous chapters. In order to place the findings of this report on Ireland in the wider context, issues at European level are firstly considered. A further objective of this chapter is to provide an initial assessment of the impact of developmental policies and investments under the National Development Plan (NDP) and the Community Support Framework (CSF) and the likely future responses needed. As noted in Chapter 15, since the present report is being prepared relatively early in the period covered by the NDP/CSF (which extends from 1994-1999), the assessment is, of necessity, largely prospective and based mainly on the experience of the programmes in the 1989-1993 period.

REVIEW OF THE EU FIFTH ENVIRONMENTAL ACTION PROGRAMME

At the request of the European Commission, the European Environment Agency (EEA) has prepared an assessment (Wieringa, 1995) of the trends, state and outlook of the environment in the European Union (EU). This forms part of the review process of the Fifth Environmental Action Programme and, in particular, it reports on whether or not the EU's environmental objectives and targets for the year 2000 will be achieved.

The report outlines a number of main conclusions, including that the EU is making progress in reducing certain pressures on the environment. However, this progress is not sufficient to improve the general quality of the environment, and there is even less progress towards sustainability. Without accelerated policies, the pressures will continue to lead to the exceedence of the often limited carrying capacity of the environment. Actions taken to date will not lead to full integration of environmental considerations into economic sectors or to sustainable development.



A number of specific trends apparent from the review are outlined in the box below.

Environmental Trends in Europe

Successes have been noted in relation to the following:

- reduction of ozone-depleting substances;
- reduction of emissions of heavy metals and sulphur dioxide;
- improvement of some aspects of surface water quality, i.e., reduction in organic matter and phosphorus (but increase in nitrogen levels);
- targeting point sources of pollution, mainly in the industrial sector.

Further attention is required at European level in relation to the following:

- transport - a sector where higher growth has made the situation worse; traffic related issues, e.g., nitrogen oxides emissions, urban air quality and noise;
- climate change and acidification; carbon dioxide emissions after the year 2000;
- groundwater quality (pesticides and nitrates);
- the quality of marine water; coastal zone management;
- habitat destruction and fragmentation;
- targeting of diffuse sources of pollution;
- degradation of soil quality; erosion and desertification;
- waste management;
- chemicals in the environment.

It appears also that meeting volatile organic compound (VOC) targets by the year 2000 is not assured.

(Wieringa, 1995).

It was concluded that one of the key issues for the future should be efficiency, in terms of maximising environmental benefits, while minimising economic costs. Upward trends in population and economic growth are translating into increases in the following: energy use, material use, transport and tourism. If the EU is to achieve its environmental targets, then an accelerated environmental policy is needed. It should be noted that the trends outlined above relate to Europe as a whole and are not necessarily reflected in each individual country.

THE NATIONAL DEVELOPMENT PLAN AND COMMUNITY SUPPORT FRAMEWORK

The basic aim of the NDP/CSF is to turn investment into employment - in industry, services, natural resources, tourism and construction. The Plan aims at achieving balanced regional development and a successful agriculture and food sector. In achieving the objectives of the Plan it is proposed to respect the principle of sustainable development and the protection of the environment. In this regard, it provides for major investment in direct environmental services and the approach to economic infrastructure includes, for example, increased investment in public transport.

The programmes that involve the largest levels of investments and are of particular significance to the environment are briefly outlined below. The background and the relevant investment proposals are first addressed in a general way and this is followed by a brief discussion of environmental considerations. Further general background information on the main sectors has been presented in Chapter 2, and economic aspects of certain sectors have been discussed in Chapter 15.

Industry

Background and Investment Proposals

Ireland's industrial development policy aims at promoting a strong enterprise sector which will make the maximum contribution to sustainable development which respects the environment. The policy is intended to achieve, *inter alia*, the development of the country's natural resources as a foundation for increased industrial expansion, with particular emphasis on the growth of the food-processing and timber industries. In relation to inward investment, there is a continuing focus in respect of particular sectors including healthcare, electronics and pharmaceuticals.

The NDP notes the significance of activities aimed at reducing the impact of industry through the application of new cleaner technologies.

Environmental Considerations

The sectors targeted for development include a strong focus on the users of renewable resources, e.g., food and forestry based industries, and therefore can provide important steps towards sustainability. Such industries, however, can give rise to the generation of significant liquid effluent discharges and other emissions. Hence there is a particular need for effective environmental management and control.

The setting up of the Environmental Protection Agency (EPA) in 1993 and with it the introduction of integrated pollution control (IPC) licensing has marked a significant change in the way that industries are controlled and monitored in relation to the environment. The application of IPC, involving best available technology not entailing excessive costs (BATNEEC), can help ensure that industrial developments, such as those referred to above, will take place in a manner which is both responsible and sustainable.

The Report of the Industrial Policy Review Group recognised Ireland's 'green image' as something which could bring competitive advantage provided it is preserved and enhanced. The NDP/CSF acknowledges that Ireland's green image is a crucial factor for success in the fields of industry and tourism. Implementation of the industrial development priorities of the CSF is to be based on sound environmental principles which will involve the following:

- focusing on the use of cleaner technologies;
- waste minimisation and recycling;
- pursuing a policy of conservation of energy and other raw materials.

It is apparent that, up to the present time, there has been insufficient co-ordinated information on emissions to the environment from industry. In particular, no major work has been undertaken in the past decade on the preparation of inventories of emissions of the more significant substances such as trace metals. There is a need to develop and maintain a national inventory of this type. According as the implementation of IPC licensing and compliance monitoring develops to cover all of the categories of activities listed in the First Schedule of the Environmental Protection Agency Act, 1992 (EPA Act), then the groundwork will have been laid to facilitate a consistent national inventory of emissions from the major potential sources, such as the larger industries. Such an inventory will require to be combined with information on point emissions from non-IPC industries, from sewerage schemes and from other sources.

A document entitled *Cleaner Manufacturing Technologies in Ireland* was published by the Department of the Environment in October 1993. It discusses the potential to reduce the environmental impact of industry through the application of new cleaner technologies. This issue is addressed in greater detail in BATNEEC guidance notes which have been prepared in draft form by the EPA for a wide range of activities. Some of these have now been published, e.g., for chemicals and waste (a guidance note on noise has also been published). Considerable potential exists for the development of cleaner technologies.

Overall, the new institutional arrangements have the potential to overcome many of the problems that arose in relation to industrial development in the past. The broadening in the range of instruments, such as voluntary environmental management schemes, is a further step on the road to sustainability. These positive developments, however, will take some time to reach full fruition; for example, IPC licensing is, of necessity, being introduced on a phased basis. Further reductions in the impacts of industry are needed. For the 1991-1994 review period, the suspected cause of almost half of the total seriously polluted river length, affecting 37.5 km of channel in all, was industrial type activity (although it should be noted that a high proportion of the length is accounted for by the R. Avoca, where past mining activity is causing continuing pollution).

Transport

Background and Investment Proposals

The NDP/CSF notes that roads are the dominant mode of internal transport (see Chapter 2), and that there are significant investment needs for both the road and the railway infrastructure. Environmental sustainability is to be given special consideration in the integrated transport investment programme, which includes the following features:

- a development strategy for the national primary road network;
- the improvement of other roads of economic importance;
- upgrading the mainline rail network;
- substantial investment in implementation of the Dublin Transportation Initiative;
- development of the three main airports;
- targeted investment in ports.

The Operational Programme (OP) for Transport 1994-1999 covers these various aspects and involves a total investment of £1,137 million. Increased emphasis is placed on rail transport, urban public transport and local road networks compared to previous programmes. The percentages (of the total budget) devoted to these areas in the two periods show this increasing emphasis, as follows:

Operational Programmes

	1989-93	1994-99
Railways:	3 per cent	11 per cent
Non-national roads:	8 per cent	17 per cent
Urban transport:	2 per cent	14 per cent

The increased investment in rail transport is designed to encourage greater use of this mode of transport for both passenger and freight traffic. It also aims at promoting energy efficiency and at improving safety in the overall transport sector.

In order to help reduce congestion, accidents and emissions, the Dublin Transport Initiative (DTI) aims at encouraging commuters to switch from the car to public transport. To this end, it aims at reducing the relative attraction of private transport and providing viable alternatives.

Environmental Considerations

The GREEN 2000 Advisory Group (Chapter 1) concluded that a proper recognition of the contribution of transport to the national economy is fundamental to addressing its environmental consequences. The review of the previous programme emphasised the continuing importance of road improvements. Road transport is also one of the areas where economic instruments have been used to good effect. On the other hand, recent estimates suggest that the environmental cost of transport is relatively high in monetary terms. These aspects are addressed further in Chapter 15.

Many recent road schemes have involved the diversion of traffic away from city and town centres, and this is clearly of benefit to the urban environment, for example in terms of air quality, noise and traffic congestion. The quality of landscaping along many recent road developments has been high. The further development of ring roads, by-passes and river crossings under the Plan will continue to produce such benefits. Similarly, the increased emphasis on investment in public transport, specifically mainline rail and light rail, is even more important in environmental terms.

There is a clear need to ensure that, notwithstanding the net benefits of schemes such as by-passes, for example in relation to noise exposure (Chapter 13), new environmental problems are not created in or around the areas where the new infrastructure is being developed - hence the importance of environmental impact statements (EISs).

An EIS is required for all motorway proposals and for certain non-motorway roads. The Minister for the Environment has the power to require an EIS for other road projects which the Minister considers would be likely to have significant effects on the environment.

The poor condition of many local roads has, in itself, been one of the adverse features of the built environment in Ireland in recent years. Coastal erosion and flooding pose risks of further deterioration of the local roads infrastructure in some areas. A further issue is that even relatively minor or temporary road works can have significant impacts in certain sensitive environments.

Predictions have been made that implementation of the DTI would produce important positive impacts by the year 2011, including the following: reduced congestion, increased use of public transport, reduced energy consumption (by 9 per cent), and reduced emissions of different pollutants (by 7 to 13 per cent).

Overall, the growing significance of road transport as a contributor to air emissions is perhaps the most significant recent environmental trend, both at national and at European levels. In this context, the main benefit of road development proposals, such as by-passes, will be to reduce urban air pollution.

Energy

Background and Investment Proposals

Considerations in relation to energy policy in Ireland include the supply of a choice of fuels, competitive pricing, supply security, socio-economic and environmental considerations, efficiency in consumption, and the use of indigenous sources as much as is economically possible. Energy policy focuses on tackling the factors which give rise to competitive disadvantages as well as maximising efficiency in fuel consumption and energy infrastructure.

The contribution of the various fuels to the primary energy requirement has been presented in Chapter 2. Dependency on oil reduced from 70 per cent to 43 per cent over the 1980s; it has increased somewhat again to 51 per cent in 1994. Since 1980, indigenous natural gas has taken a significant share. Economic aspects of energy, particularly in relation to the encouragement of energy conservation and of alternative energy sources, have been outlined in Chapter 15.

The NDP/CSF notes that the most significant investments relate mainly to expanding the electricity generating capacity, rural electrification, energy conservation and efficiency and emissions reduction. Initiatives are proposed in relation to combined heat and power, converting waste to electricity, biomass, wind power and small hydro-electric stations, along with investigations on links to clean manufacturing technologies. Specific proposals include provision for a new peat-fired generating station in the midlands.

Significant investment in the energy sector is provided for under the NDP/CSF. A total investment of £191 million will be undertaken under the Economic Infrastructure Operational Programme. This programme will concentrate on the environmental benefits which will result from the assisted investments in the energy sector.

Environmental Considerations

The environmental objectives of energy policy in Ireland relate to energy conservation, alternative energy sources (particularly renewable sources), and reducing the adverse effects on the environment of energy production and use. The Government has recognised the strong economic and environmental arguments that exist for energy conservation. In order to make further progress in this area the Government has committed itself to contributing to the preparation of a European carbon/energy taxation policy (Department of the Environment, 1995).

Energy intensity (energy consumption per unit of GDP) in Ireland, in common with the situation in the rest of the EU, has been falling. Per-capita energy consumption in Ireland has been rising, and energy use in buildings accounts for about 50 per cent of the national total (Chapter 2). Improved energy conservation in buildings is clearly an important objective. Specific measures aimed at energy conservation are included in the Building Regulations, which came into effect in 1992. Transport accounts for about one-fifth of energy demand and as noted earlier in terms of environmental pressures is also a particularly important sector.

Renewable sources currently provide just two per cent of Ireland's energy requirements. There is considerable potential for new and alternative sources of energy. Recent initiatives include a biofuel trial project undertaken by Cork County Council, and various other initiatives have been outlined in Chapters 2 and 15. It is essential that a strong focus be maintained on developing renewable energy sources.

Peatlands have traditionally been an important fuel source in Ireland. The anticipated production life-span of the peatlands earmarked for continued exploitation is a few decades. It may be noted also that, for Ireland, the most significant predicted adverse consequence of climate change is how it would affect peatlands. Overall, Ireland's peatlands require to be managed as an indigenous resource which is of importance from various perspectives, including energy, employment and biodiversity. Conservation measures are now being put in place in respect of peatlands of natural heritage importance.

Agriculture

Background and Investment Proposals

The NDP/CSF notes the importance of integrating agriculture into a wider rural development framework. Objectives include higher levels of efficiency, quality, market orientation and competitiveness in all areas of agriculture and food production. The strategies proposed to achieve the objectives include supporting the achievement of the highest environmental standards. Continued support is to be made available for non-surplus products, rural tourism, and investment in farm pollution control.

Environmental Considerations

The NDP/CSF emphasises the special attention being given to the environment, and the considerable progress that has been made with farm pollution control in recent years. Measures to combat farmyard pollution included in the last OP will be continued under the new agri-environment schemes over the period 1994-1999. Further measures in this area will be introduced in relation to nutrient management on farms to reduce further impact on the environment. Nutrient management will also be promoted when IPC licensing is applied to the pigs and poultry sectors. The Rural Environment Protection Scheme (REPS) was introduced in 1994 to promote environmentally friendly farming practices (Chapter 14).

Agriculture has had an impact on the environment in various ways. Examples include, in particular, eutrophication of waters and increased soil erosion and vegetation damage in some hill areas, particularly as a result of increased sheep numbers. The problems of fish kills has been significantly reduced by regulatory and educational measures.

The evaluation of the previous Operational Programme for the Control of Farmyard Pollution (Fitzpatrick Associates, 1992) concluded that investment in pollution control facilities would appear to be reducing pollution from the participant farms. Less tangible on-farm benefits included preservation of the natural environment necessary for development of rural tourism, and preservation of Ireland's green image from a food production viewpoint. In relation to farm practices, which were not explicitly included in the programme content, some questions arose from the evaluation. Specific suggestions regarding future programme content included a broader range of anti-pollution and environmentally friendly farming measures. These in general have been taken up in the REPS scheme.

The evaluation noted that there was a danger that EU assistance could be contradictory, leading to environmental damage while simultaneously funding measures to offset this. It was concluded that areas which clearly needed attention are the environmental implications of headage

payments generally, and the ewe premia in particular, and the dangers of overgrazing and intensive agriculture.

Sheep numbers have now stabilised or reduced somewhat nationally (Chapter 2), but the issue of the extent of damage caused by overgrazing to date and of sustainable stocking levels merits further attention.

Organic farming has developed gradually in Ireland over the past twenty years. It represents a sustainable lifestyle for some farmers and supports are available (Chapter 15).

Overall, the general trends of declining incidents of fish kills up to 1994 reflected a vigorous response by the relevant authorities and by farmers. It is essential that this response is maintained (note that fish kills increased in 1995). The less dramatic but nonetheless serious steady decline in river water quality is attributed mainly to eutrophication.

Forestry

Background and Investment Proposals

Forestry in recent years has been given a particularly high priority by the Government as it has the potential to contribute substantially to national and regional development and offers an alternative source of income to farmers. The strategy is to continue the development of the primary forestry sector and the development of an efficient and competitive downstream processing sector. A planting programme of 30,000 ha per annum to the year 2000 is planned.

Environmental Considerations

Ireland has a particular advantage in terms of the rate at which trees grow in this country, which greatly exceeds rates elsewhere in Europe. This gives particular emphasis to forestry as a renewable industry for Ireland. As perhaps the most rapidly changing feature of land-use in Ireland, afforestation and its potential advantages and disadvantages in environmental terms (Chapter 11) require particular attention.

In relation to afforestation, environmental impact statements (EISs) and planning permission are required for planting projects of 200 hectares or more. The National Parks and Wildlife Service has expressed the view that this threshold is too high to be effective from a nature conservation point of view and needs to be reduced significantly (Chapter 12) in areas designated for conservation. This proposal is considered to be important for the ordered development of forestry in harmony with the environment. Consideration should also be given to new measures to be taken to ensure that where two or more developments take place in close proximity to one another then, if the combined developments exceed the

threshold they should require an EIS. (Similar considerations apply in respect of the limit of 50 ha for peat production).

Ireland lacks the 'forest culture' which is a feature of several other European countries with greater proportions of land covered by trees. Integration of the commercial and the recreational and other aspects of forestry wherever possible would have particular advantages for the successful integration of an expanded forestry element into the rural environment. This ties in to the general need for an overall landuse policy for the protection of landscapes and the rural environment.

Fisheries and Aquaculture

Background and Investment Proposals

Aspects of the fisheries sector were outlined in Chapter 2. The NDP/CSF notes that notwithstanding significant growth in recent years, the sector remains underdeveloped and suffers from major structural weaknesses. It offers considerable potential for further development. Investment in the fishing industry is being targeted at achieving growth and employment in coastal communities. It aims at bringing about a sustainable balance between the available fish resources and their exploitation, and concentrates on underexploited fishing opportunities. The objectives for aquaculture include continued sustainable expansion in output, new species, more efficient production, and reduced disease incidence. A stronger fish processing and marketing base is to be developed. Infrastructure at fishery harbours is to be upgraded.

Environmental Considerations

Environmental protection provisions that have been introduced in the fisheries sector include requirements that larger finfish farms must produce an EIS. The proper regulation and control of fish farms is essential.

Issues of sustainability and the protection of the environment arise on several fronts in relation to fisheries, aquaculture and fish processing. Mention is made in Chapter 9 of the dramatic decline in sea trout stocks in certain areas and of the serious situation in respect of spring salmon. Fish processing wastes require particularly effective treatment and disposal facilities to avoid pollution problems.

In relation to inland fisheries, both a landuse policy and river catchment management are considered essential by the Central Fisheries Board if the available natural resources are to be optimised. The factors having an adverse impact on fish stocks in rivers include organic pollution, eutrophication, loss of habitat, imbalanced riparian zones (excess shading, overexposure, increased bankside erosion and siltation), depressed water levels in certain periods and elevated current velocities in others.

Tourism

Background and Investment Proposals

The traditional strengths of Irish tourism have been identified as its people, scenery, cultural heritage, environmental quality and worldwide ethnic links. Changing trends in the nature of international tourism demand are favourable for Ireland, e.g., a growing preference for activity-based holidays, environmental awareness, and increased demand for holidays in more temperate climates.



The targets for tourism include improving the seasonality profile, ensuring that investment in tourism is sensitive to the environment, and the upgrading and improvement of tourist angling waters. The NDP/CSF notes the risk to tourist angling posed by the deteriorating quality and level of Irish fish stocks, and proposes measures to address this. It notes also that tourism will benefit from aspects of other programmes, e.g., roads, sanitary services and urban renewal.

In the Operational Programme for Tourism 1994-1999, up to 75 per cent of all EU investment in physical developments is being directed at enhancing existing tourism infrastructure rather than creating new tourist developments. Also, increased emphasis is being placed on improving the seasonal spread of tourism, in order to reduce pressures on sensitive areas during the peak season. Overall investment in the tourism industry is being widely dispersed to minimise capacity problems in individual areas (Department of the Environment, 1994).

Environmental Considerations

Bord Failte acknowledges that, although Ireland has been spared the worst excesses of ugly tourism development, there is no cause for complacency. It has been suggested that Comprehensive Area Management Plans are urgently required for a small number of areas in the country where the landscape is particularly sensitive and which are coming under significant tourism pressure. These include: the Burren, Connemara, the Ring of Kerry, the Dingle Peninsula and the Wicklow Mountains. The National Park concept is considered to have been a powerful force for landscape and nature protection, and the development of a further National Park in the Nephin Mountains area of North Mayo is considered to be of benefit to tourism potential by providing a vital link in the network of important tourism sites along the west coast.

Recent planning reforms are also expected to enhance the protection of scenic areas, but the need for other improvements has been identified by Bord Failte, including strict enforcement of planning laws and measures to address the problems of visual impact that have arisen with new housing in the countryside.

The conservation of flora, fauna and their habitats is also considered by Bord Failte to be a crucial factor for tourism, and there is a need for a balanced strategy of habitat protection and planned visitor access. There is a need for a greater understanding of how to minimise the impacts on tourism from developments in other economic sectors. It is concluded that aquaculture, mining, and afforestation are all activities which can develop in harmony with tourism, if properly regulated.

Bord Failte identifies deficiencies in environmental management in a number of areas, including litter, waste disposal, abandoned cars, advertising signs/hoardings, flyposting/graffiti, maintenance of amenities and coastal erosion. The main conclusion is that the future of Irish tourism is inextricably linked to the quality of the environment.

Local Development

Background and Investment Proposals

The elements of the local development programme in the NDP/CSF include local enterprise, targeting of deprived areas, employment development, and urban renewal. The objectives of area-based local development include achieving substantial improvement in the physical environment of the areas concerned. In relation to urban renewal, the objective is to improve the fabric of the built environment, with a heavy emphasis on architectural conservation and streetscapes.

Environmental Considerations

The predicted impacts of this programme include environmental improvement that would create the necessary local conditions for development. The development of Local Agenda 21 will also be particularly important in this context (Chapter 14). Many of the continuing environmental problems listed above as having adverse effects on tourism are ones which require action to be taken at local level.

Environmental Services

Background and Investment Proposals

Direct investment is provided for in the NDP/CSF in relation to water and sewerage schemes, solid (including hazardous) waste disposal infrastructure, coastal protection and environmental research and monitoring. General

aspects of the Operational Programme for Environmental Services 1994-1999 have been outlined in Chapter 15.

Major coastal sewage treatment schemes will form the largest single component of water and sanitary services investment. Sewerage services will also be developed at selected inland locations. In relation to solid waste, the objective is to work towards an integrated and adequate network of waste disposal installations, with appropriate provision for hazardous and non-hazardous waste management and disposal.

The EPA has a central role in administering the environmental monitoring research and development sub-programme (Chapter 3). Selected R & D and demonstration projects will continue to be co-funded in the areas of (a) environmentally sustainable resources management and (b) cleaner production.

The coastal protection sub-programme has the primary objective of protecting local infrastructure. Issues considered include the introduction of shipping traffic surveillance infrastructure and marine pollution prevention facilities around the Irish coast in the context of a European programme.

Environmental Considerations

Expenditure on environmental infrastructure includes sewerage schemes for Dublin, Cork, Limerick, Dundalk, Drogheda, Greystones, Wexford and Waterford. Some of these towns and cities have adjacent bathing beaches, while others have adjacent shellfisheries. The reduced discharges of potential pathogens in treated sewage will help ensure the continued and enhanced protection of these water uses, for which the quality requirements are particularly high. Estuarine water quality problems have also been in evidence in some cases. In general, significant benefits can be expected in the enhancement of the aquatic environment, resulting from these schemes, which will result in the ending of the discharge of untreated sewage to tidal waters from large towns and cities.

A schedule of 'sensitive areas' has been prepared as part of the urban waste water treatment Regulations, 1994 (see box). More stringent treatment than secondary treatment is required in respect of all discharges from urban areas with a population equivalent of more than 10,000 into sensitive areas or into the relevant catchment areas of sensitive areas, where the discharges contribute to the pollution of these areas.

Sensitive Areas

- River Boyne, Co. Meath (a 6.5 km section);
- River Camlin, Co. Longford (lower reach);
- Castlebar River, Co. Mayo (section);
- Liffey, Co. Kildare (section);
- River Nenagh, Co. Tipperary (section);
- River Tullamore, Co. Offaly (a 0.5 km section);
- Lough Derg on the River Shannon;
- Lough Leane, County Kerry;
- Lough Oughter, County Cavan;
- Lough Ree on the River Shannon.

Continued surveys are underway to help assess whether there are tidal waters that should be classified as sensitive in relation to eutrophication. The continuation of these surveys and the implementation of any further investigations in this regard are important priorities.

FUTURE OUTLOOK

Driving Forces and Pressures

There will be a continuing need to ensure that the correct balance is achieved in setting and meeting the objectives in relation to energy supply and energy use. Key issues include energy conservation, maximising efficiency and the use of renewable sources, careful husbandry of indigenous energy resources, and minimising emissions to the environment.

Although the EU target is the stabilisation of carbon dioxide (CO₂) emissions by the year 2000, emissions in Ireland are to be limited to an increase of 20 per cent over 1990 levels (Chapter 5). Considerable effort will be required to achieve the minimisation of CO₂ emissions. The situation of continuing increases in emissions of nitrogen oxides and volatile organic compounds, mainly from transport, is also of concern.

Various information gaps have been identified in the course of the preparation of this report. There is a particular need for more systematic information on emissions to the environment and on exposure to excessive noise levels. A database including these aspects is to be developed as required under the EPA Act. Better inventories of emissions to air are also a prerequisite for projections of the likely future emission scenarios. A further gap is in up-to-date inventories of discharges to the aquatic environment of substances such as nutrients and toxic, persistent contaminants.

In relation to waste, there is also a need for reliable statistics, and this is being addressed in a project initiated by the EPA (Chapter 7). There is also a need for information on abandoned landfill sites and, in particular, sites used for the disposal of hazardous wastes. There is a need for ongoing evaluation of the success of recycling and waste prevention generally.

In relation to emissions inventories, more work needs to be done, particularly, as noted earlier, in relation to major emitters such as industry. It is essential that the options for reducing emissions be kept under regular review.

State

In general terms, the available data indicate that the quality of the Irish environment is good and compares favourably with most other States in the EU. This favourable position reflects to a large degree the country's geographical situation with low population density and relatively moderate development in the industrial and agricultural sectors. The value of the green image of Ireland is a constantly recurring theme in many plans and programmes, particularly in relation to the marketing of food and of the country as a tourist destination.

For reasons such as these, as well as for its intrinsic value, the environment in Ireland requires to be protected and where necessary enhanced in a period of economic growth, in order that such growth and development are sustainable.

It is apparent from a recent assessment of the environmental state of surface freshwaters in Europe (Kristensen and Hansen, 1994) that Ireland's rivers are among the cleanest in Europe. The assessment was made on the basis of chemical sampling results, and there were some difficulties in the comparability of information across Europe. Through the co-ordinating role of the EEA it is expected that, in future, better comparability across Europe will be achieved for information on the quality of water and the other environmental media.

The underlying causes of the continuing increase in the extent of slight to moderate pollution of rivers in Ireland (as shown from biological monitoring) must continue to be investigated and appropriate remedial measures put in place. Eutrophication is identified as the principal reason for this trend. Agriculture has been mainly implicated in this, and continued vigilance is needed to ensure that all appropriate action is being taken to help halt the insidious decline in the quality of Ireland's rivers. There is little evidence to suggest that this trend can be reversed without concerted action on several fronts. Farmers have an important role to play through reducing the use of phosphorus fertilisers, where appropriate.

The current status in relation to certain freshwater fish is a cause for concern. The decline of the char population is being linked to a deterioration in the environmental quality of certain lakes. It has been recommended by the Central Fisheries Board that the char should now be added to the endangered species list and that the lakes where it still occurs should be designated as Natural Heritage Areas (NHAs).

According as pressures grow from competing uses for water, greater consideration will need to be given to conservation measures, such as leakage prevention. This should apply to both domestic and industrial water use. In the latter case, all options in respect of the re-use of water should be explored, particularly in respect of major consumers. A minimum target might be to stabilise the use of water on a per capita basis.

The development of an improved information system on the quality of freshwaters in Ireland is part of an EPA project being funded under the EU LIFE Programme, which deals also with air quality, and the development of a referential database on all types of environmental data sources. A monitoring programme on groundwater quality is now being organised by the EPA.

An assessment of the marine environment around Ireland is due to get underway shortly, as part of a wider assessment of conditions in the NE Atlantic region covered by the OSPAR Convention. A Quality Status Report will be prepared by Ireland and the UK, for the 'Celtic Seas', which in addition to the seas around Ireland, include an area to the west of Scotland.

A project initiated by the EPA is addressing the need for information on PM_{10} levels in air in Dublin, and a further project will address the question of critical loads of acidifying depositions in Ireland.

In relation to the terrestrial environment, the main information gaps are in respect of the extent of soil degradation and erosion caused mainly by overgrazing on hill and mountain areas. The issue of landscape quality and its protection also merits further attention. There is a need for research on plant communities and on many of the more elusive wildlife species, and for more information on habitats.

Response

Positive developments in respect of the environment in Ireland over the coming few years up to the end of the century will result from measures that have been decided in recent years for progressive implementation. These include the continuing phased introduction of IPC licensing and the implementation of the urban waste water treatment Directive. The latter will require the cessation of the

dumping of sewage sludge at sea; it will also require additional sewage treatment which, however, will lead to increased amounts of sludge for disposal by other means.

An anti-litter initiative was recently announced and its objectives will include the following: focusing public attention on litter; stepping-up the enforcement of existing legislation; developing improved systems, including revised legislation; and developing measures consistent with the principle of shared responsibility for the environment.

Further positive developments include the Waste Management Bill, which when enacted will provide important controls for this aspect of the environment about which there is much concern. A national strategy to deal with hazardous waste is an urgent requirement. There have also been some positive developments in recycling, e.g., in respect of glass.

Progress will also be made over the coming years in the development of environmental information systems as provided for at national level in the EPA Act and at European level in the Regulation which established the EEA. Information on all aspects of the environment will be required for European reports on the State of the Environment every three years. In developing environmental information systems, emphasis will need to be given to facilitating trend analysis, the development of early warning methods and indicators and the monitoring of the effects on the environment of actions in the different sectors. The benefits of new environmental protection infrastructure, such as sewage treatment works, will also need to be monitored.

The overall question of economic instruments for environmental protection will require greater attention in the future. Certain anomalies in this regard have been noted in chapter 15. It is important that the taxation system be used as far as possible as a tool for favouring environmental protection measures of various types.

The issue of 'pollution charging' is one which must be kept under review. There is no doubt that major dischargers of emissions to the environment are availing freely of an invaluable resource, even if the capacity of the environment to absorb these emissions is generally sufficient at present.

There is a trend for noise problems to become more frequent and more prolonged, e.g., as a result of shift operations in industry. In zoning, greater attention needs to be paid to the question of noise. This applies in particular to the siting of industrial and similar activities. For example, even within industrial estates, where these are close to residential areas, the noisier activities would best be sited centrally in the estates.

The coastal zone is recognised as being particularly vulnerable to environmental degradation. It is also particularly important in the context of biodiversity. An important initiative has been undertaken, which has led to a consultancy study on coastal zone management. It is essential that appropriate measures are taken in response to this study in due course.

The diversity of organisations with responsibilities for the management of the environment and natural resources in Ireland, reflects structures which have developed over a long period, since the foundation of the State. The establishment of the EPA has represented a significant institutional development in response to the growing recognition of the importance of the environment. Other institutional developments in recent years included the establishment of the Marine Institute and the Radiological Protection Institute of Ireland. The creation of ENFO, the Environment Information Service, has been another valuable development (see Chapter 2). There is a need to ensure that maximum benefit is derived from these new institutional developments and that all aspects of the environment are considered in a coherent and integrated way.

The EPA is at present developing a national monitoring programme for the environment. The initial elements of the programme include the following:

- inland surface waters;
- groundwaters;
- estuarine and coastal water quality;
- air quality.

This programme will constitute the first co-ordinated national monitoring programme encompassing all of these environmental media.

One of the most urgent requirements regarding nature conservation is for necessary legislation to be put in place in respect of recent EU Directives and thereby giving a statutory basis to the proposed National Heritage Areas.

In future reporting on the state of the environment by the EEA it is envisaged that integrated environmental assessment will be a basic tool for developing an understanding of the driving forces, pressures and state of the environment. The EEA is approaching this through development of a general strategy, as well as strategies for integrated assessments of specific issues (problems, regions, sectors). This development is likely to be reflected also in future national approaches to State of the Environment reports, with consequent benefits to the evaluative function of such reports in respect of the effects of policies and actions that have an impact on the environment.

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ACRONYMS AND ABBREVIATIONS

AER	Alternative Energy Requirement	ELVs	Emission Limit Values
AFF	An Foras Forbartha	EMA	Environmental Management and Auditing Services Ltd.
APHA	American Public Health Association	EMAS	Eco-Management and Audit Scheme
BATNEEC	Best Available Technology Not Entailing Excessive Costs	EMEP	European Monitoring and Evaluation Programme
BOD	Biochemical Oxygen Demand	ENCY '95	European Nature Conservation Year 1995
Bq	Becquerel	ENFO	Environmental Information Services
CAP	Common Agricultural Policy	ENVIREG	An EU regional action programme
Cd	Cadmium	EPA	Environmental Protection Agency
CEC	Council/Commission of the European Communities	EPNL	Effective Perceived Noise Level
CFCs	Chlorofluorocarbons	EQOs	Environmental Quality Objectives
CH ₄	Methane	EQSs	Environmental Quality Standards
CHP	Combined Heat and Power	ERDF	European Regional Development Fund
CIE	Coras Iompair Eireann	ERL	Environmental Resources Ltd.
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora	ERU	Environmental Research Unit
CO	Carbon Monoxide	ESB	Electricity Supply Board
CO ₂	Carbon Dioxide	ESF	European Social Fund
COP-I	Conference of the Parties (First Session)	ESRI	Economic and Social Research Institute
CORINE	Co-ordination of Information on the Environment	EU	European Union
Cr	Chromium	Eurostat	Statistical Office of the European Community
CSF	Community Support Framework	FCCC	Framework Convention on Climate Change
CSO	Central Statistics Office	FEEE	Foundation for Environmental Education in Europe
CSTE	Scientific Advisory Committee on Toxicity and Ecotoxicity of Chemicals	FEOGA	European Agricultural Guidance and Guarantee Fund (French acronym)
Cu	Copper	GDP	Gross Domestic Product
DAFF	Department of Agriculture, Food and Forestry	GIS	Geographic Information System
DART	Dublin Area Rapid Transit	GNP	Gross National Product
dB(A)	Environmental noise levels assessed in terms of A - weighted decibels	GSI	Geological Survey of Ireland
DDT	Dichlorodiphenyltrichloroethane	H ⁺	Hydrogen Ion / Acidity
DO	Dissolved Oxygen	H ₂ SO ₄	Sulphuric Acid
DoE	Department of the Environment	HCH	Hexachlorocyclohexane
DoM	Department of the Marine	HFCs	Hydrofluorocarbons
DSP	Diarrhoeic Shellfish Poisoning	Hg	Mercury
DTI	Dublin Transport Initiative	HNO ₃	Nitric Acid
EAGGF	European Agricultural Guidance and Guarantee Fund	ICAO	International Civil Aviation Organisation
EAP	Environment Action Programme	ICES	International Council for the Exploration of the Sea
EC	European Communities	IDA	Industrial Development Authority
ECAC	European Civil Aviation Conference	IEEP	Institute for European Environmental Policy
ECOPRO	Environmentally Friendly Coastal Protection	IFA	Irish Farmers Association
ECU	European Currency Unit	IFSC	International Financial Services Centre
EDMED	European Directory of Marine Environmental Data	IIRS	Institute for Industrial Research and Standards
EEA	European Environment Agency	IPC	Integrated Pollution Control
EEC	European Economic Community	IPCC	Intergovernmental Panel on Climate Change
EIA	Environmental Impact Assessment	IPCC	Irish Peatland Conservation Council
EIB	European Investment Bank	IPPC	Integrated Pollution Prevention and Control
EIS	Environmental Impact Statement	IS	Irish Standard
		ISO	International Standards Organisation
		ISSCG	Irish Sea Science Co-ordination Group

IUCC	Information Unit on Climate Change	PVC	Polyvinyl Chloride
IUCN	International Union for the Conservation of Nature and Natural Resources (World Conservation Union)	R&D	Research and Development
IWC	Irish Wildbird Conservancy	RA	Risk Assessment
JAA	Joint Aviation Authorities	REPS	Rural Environment Protection Scheme
JNCC	Joint Nature Conservation Committee	RPII	Radiological Protection Institute of Ireland
K	Potassium	RSPB	Royal Society for the Protection of Birds
L ₁₀	The noise level which is exceeded for 10 per cent of the measurement period	RTC	Regional Technical College
LCPs	Large Combustion Plants	S	Sulphur
L _{eq}	The steady noise which over a given period has the same acoustic energy as the actual noise	SACs	Special Areas of Conservation
LIFE	Community Financial Instrument for Environment	SARPs	Standards and Recommended Practices
LPG	Liquefied Petroleum Gas	SI	Statutory Instrument
LU	Livestock Units	SO ₂	Sulphur Dioxide
MCOS	M.C. O'Sullivan and Co. Ltd.	SO ₄	Sulphate
N	Nitrogen	SO _x	Sulphur Oxides
NA	Not Applicable	SPAs	Special Protection Areas
N ₂ O	Nitrous Oxide	SS	Suspended Solids
NDP	National Development Plan	STRIDE	Science and Technology for Regional Innovation and Development in Europe
NGOs	Non-Government Organisations	TAC	Total Allowable Catches
NH ₃	Ammonia	TBT	Tributyl Tin
NH ₄	Ammonium	TCD	Trinity College Dublin
NHAs	Natural Heritage Areas	TDS	Tonnes of Dried Solids
Ni	Nickel	TOC	Total Organic Carbon
NLVs	National Limit Values	TOE	Tonne of Oil Equivalent
NNI	Noise and Number Index	UCC	University College Cork
NO	Nitric Oxide	UCD	University College Dublin
NO ₂	Nitrogen Dioxide	UK	United Kingdom
NO ₃	Nitrate	UKRGAR	United Kingdom Review Group on Acid Rain
NO _x	Nitrogen Oxides	UN	United Nations
NPWS	National Parks and Wildlife Service	UNCED	United Nations Conference on Environment and Development
NUTS	National Units for Territorial Statistics	UNECE	United Nations Economic Commission for Europe
O	Atomic Oxygen	UNEP	United Nations Environment Programme
O ₂	Free Oxygen	UNESCO	United Nations Educational, Scientific and Cultural Organisation
O ₃	Ozone	USA	United States of America
OECD	Organisation for Economic Co-operation and Development	UV-B	Ultraviolet B radiation
OP	Operational Programme	VAT	Value Added Tax
OPP	Operational Programme on Peripherality	VOC	Volatile Organic Compounds
OPW	Office of Public Works	WHO	World Health Organisation
OSPAR	Oslo and Paris Conventions	WPAC	Water Pollution Advisory Council
P	Phosphorus	WTO	World Trade Organisation
Pb	Lead	WTTERC	World Tourism and Travel Environment Research Centre
PCBs	Polychlorinated Biphenyls	WWF	World Wide Fund for Nature
PICs	Products of Incomplete Combustion	Zn	Zinc
PM ₁₀	Particulate Matter measuring less than 10 microns in diameter		
PNdB	Perceived Noise decibel		
PNL	Perceived Noise Level		
PSP	Paralytic Shellfish Poisoning		
PSR	Pressure-State-Response		

GLOSSARY

Acidification: Continuing loss of capacity to neutralise acid inputs indicated by declining alkalinity and increasing hydrogen ion concentration (i.e., the decrease in pH of water or soil resulting from increases in acidic anion inputs such as sulphate).

Acid Sensitive: Surface water and soils that, due chiefly to their low calcium concentration, have little or no resistance to acid inputs.

Aerosol: A suspension of solid or liquid particles in a gaseous medium.

Algae: Simple aquatic plants that may be attached or free floating (planktonic) and occur as single cells, colonies, branched and unbranched filaments.

Algal Bloom: Dense growth of planktonic algae or most commonly Cyanobacteria (blue-green bacteria formerly classified as algae) in nutrient enriched lakes causing discoloration of the water.

Algal Cysts: Thick walled resting algal cells.

Ammonia (NH₃): A simple form of nitrogen primarily originating in waste discharges. It can be toxic to fish under certain circumstances and is a source of nitrogen for plants and algae.

Anthropogenic: Produced as a result of human activities.

Aquaculture: The breeding and rearing of freshwater or marine fish in captivity.

Aquifer: A rock unit that will yield water in a usable quantity to a well or spring. A geological formation through which water can percolate, sometimes very slowly for long distances.

Arctic-Alpine: A plant or animal found today mainly in the Alps or in the Arctic regions or both.

Becquerel (Bq): A standard unit of radioactivity of a substance that is decaying spontaneously at the rate of one radioactive disintegration per second.

Beneficial Use: A use of the environment, or some part of it, (e.g., for recreation, agriculture and water storage) which benefits a human population and which should be protected so its use may continue.

Biochemical Oxygen Demand (BOD): A simple measure of the oxygen consuming capacity of a water sample resulting from the biochemical oxidation of organic matter in the water. BOD is normally measured by incubating a standard volume of water or waste water for five days at 20°C in the absence of sunlight and measuring the amount of oxygen consumed.

Biodegradation: The breakdown of substances by micro-organisms.

Biodiversity (Biological Diversity): A word that describes all aspects of biological diversity but especially species richness, the complexity of ecosystems, and genetic variation.

Biogenetic Reserves: Network of protected areas with certain characteristic criteria, to guarantee the biological balance and to make the ecosystems available for biological research.

Biomass: The weight of biological matter. Standing crop is the amount of biomass (e.g., algae) in a waterbody.

Biosphere: That part of the land, sea, and atmosphere in which organisms live.

Biosphere Reserves: An area of land or coast that has been designated by IUCN and UNESCO as being of international importance for conservation and study.

Biota: The flora and fauna of an area.

Biotechnology (Bioengineering): The employment of biochemical processes on an industrial scale, most notably recombinant DNA techniques, to reproduce drugs or (by means of fermentation) bulk foodstuffs for humans or livestock, sometimes by the recycling of wastes.

Biotope: A habitat which is uniform in its main climatic, soil and biotic (living or biological in origin) conditions.

Bivalve: Species consisting of two valves or shells, e.g., cockles and mussels.

Black Smoke: The fraction of total suspended particulates in air determined from the blackness measurement of the stain produced by passing the air through standard filter paper.

Blanket Bog: An area, often very extensive, of acid peatland, found in constantly wet climates, characteristic of broad flat upland areas, which develops where drainage is impeded and the soil is acid.

Brackish Water: Water which contains 0.5 - 30 parts per thousand of salinity.

Bryophyte: A non-woody plant of small size that reproduces by spores, e.g., mosses and liverworts.

Calcirole Plants: Plants which grow best on calcareous soils.

Calcifuge Plants: Plants which grow best on acid soils.

Carbon Dioxide (CO₂): A colourless, odourless, incombustible gas present as a minor constituent of the atmosphere, where it comprises 0.35% by volume.

Catch Crop: A minor crop (in terms of output) that is planted in the same year as, but immediately after, the main crop to 'catch' remaining soil moisture and nutrients.

Catchment Area: The area from which a major river system or lake derives its water (i.e., the area drained by a river system).

CFCs (Chlorofluorocarbons): A range of compounds of chlorine, fluorine and carbon implicated mainly in the destruction of stratospheric ozone but also in enhancing the greenhouse effect.

Chlorophyll: The green pigment found in algae and higher plants which is involved in photosynthesis.

Cutaway Bog: The peatland area left after peat extraction.

DDT (Dichlorodiphenyltrichloroethane): A persistent organochlorine insecticide which was introduced in the 1940s.

Decibel (dB): The unit of measurement of sound intensity.

Denitrification: The breakdown of nitrates by bacteria resulting in the release of free nitrogen.

Deoxygenation: The reduction of dissolved oxygen in water.

Dioxins: A collective name given to a group of 75 closely related chemical compounds known as polychlorinated dibenzodioxins (PCDDs). Dioxins can form during combustion of organic materials containing chlorine, as undesirable by-products during chemical manufacture and bleaching operations.

Dissolved Oxygen (DO): A measure of the concentration of oxygen in a liquid, such as water or waste water, usually expressed in mg/l or per cent saturation.

Drumlin: A low hill of glacial boulder clay, considered to have been fashioned beneath an ice-sheet.

Dungstead: Enclosures or stockades, the walls of which are constructed from pre-treated timbers or precast concrete beams that form permeable barriers through which the liquid fraction of the farmyard manure can drain.

Ecology: The study of the relationship among organisms and between those organisms and their non-living environment.

Ecosystem: A community of interdependent organisms together with the environment they inhabit and with which they interact, and which is distinct from adjacent communities and environments.

Effluent: Liquid wastes.

Emission Limit Values (ELVs): Legally enforceable limits on the physical, chemical or biological characteristics of a point source of emission to water or air, normally expressed as a maximum permissible concentration of a specified substance.

End Moraine: An accumulation of gravel and blocky material deposited at the margins of an ice-body.

Environmental Medium: Major compartment of the environment, e.g., air, water and soil.

Environmental Quality Objectives (EQOs): Descriptions of the intended use of an environmental medium; the use to which the medium is to be put defines the quality required to be maintained.

Environmental Quality Standards (EQSs): The concentrations of specific parameters in an environmental medium required to achieve or sustain a particular EQO.

Epizoite: An animal which lives attached to another animal but is not a parasite (e.g., a limpet on a crab shell).

Esker: A long, sinuous ridge of sand and gravel, formed by a sub-glacial stream but which, after the melting of the ice-sheet, was left unrelated to the surrounding topography.

Eutrophic: Greek for well nourished. Applied to waterbodies with high nutrient concentrations leading to large algal standing crops.

Eutrophication: The changes associated with enrichment of a waterbody with inorganic plant nutrients, particularly nitrogen and phosphorus.

Evapotranspiration: The loss of water from the earth's surface as a result of the combined effects of evaporation directly and transpiration, which is the loss of water from the pores in the leaves of plants.

Exotic Organism: A species found in a region to which it is not native.

Fauna: Animals

Fen: An area of waterlogged peat which, unlike bog, is alkaline or only slightly acid.

Fertiliser: Any substance that is applied to land as a source of nutrients for plant growth.

Flora: Plants

Furans: Derivatives of furan, a heterocyclic compound of chemical formula C_4H_4O comprising a ring of four carbon and one oxygen atom, with a hydrogen atom attached to each carbon atom.

Geographical Information System (GIS): A set of integrated techniques for storing, retrieving, transforming and displaying spatially referenced thematic data in map form.

Geomorphology: The study of the form and development of the Earth, and especially of its surface and physical features, and of the relationship between these features and the geological structures beneath.

Green Accounting: Accounting methods which take into consideration positive or negative impacts on the environment and natural resources.

Greenhouse Effect: Enhanced warming of the atmosphere due to the reduction in outgoing solar radiation resulting from increased concentrations of gases, in particular, CO_2 .

Groundwater: Water that occupies pores and crevices in rock and soil, below the surface and above a layer of impermeable material, (see aquifer).

Growth Limiting Nutrient: Essential element of a food chain, supplies of which are readily exhausted, thus a factor which controls the growth of organisms.

Habitat: The dwelling place of a species or community, providing a particular set of environmental conditions (e.g., forest floor, sea shore).

HCH (Hexachlorocyclohexane): An organochlorine insecticide used to control insect soil pests, aphids, mites.

Heathland: Any tract of land which is typically the habitat of many of the ericaceous (woody) shrubs.

Heavy Metal: A metal with a high relative density.

Herbicide: A chemical which is used to kill weeds.

HCFCs (Hydrochlorofluorocarbons): Compounds which have been substituted for CFCs as the latter become phased out by international agreement.

HFCs (Hydrofluorocarbons): See HCFCs

Integrated Pollution Control (IPC): A system of licensing which covers all emissions to air, water and land, including noise and is intended to minimise the impact on the environment by taking account of pollution that may be transferred from one environmental medium to another.

Invertebrates: Animals which do not possess a backbone.

Isohyet: A line drawn on a map to connect points of equal average rainfall.

Leaching: The removal of the soluble constituents of a rock, soil or ore (that which is leached being known as the leachate) by the action of percolating waters.

Lichen: A "plant" without stem or leaves, usually greyish in colour, growing on rocks or tree bark, and formed by an association between a fungus and algae.

Littoral: The area between the low and high springtide levels (marine) or the shoreline (lakes).

Machair Sand Dune: Herb-rich calcareous (i.e., containing calcium carbonate) grassland which grows on shell sand.

Macrophytes: Rooted and floating aquatic plants.

Methane (CH_4): The simplest hydrocarbon and an important greenhouse gas. It is a product of anaerobic decomposition.

Mollusc: A member of the Mollusca, a large division of the animal kingdom, including snails, oysters and octopuses.

Natural Heritage Areas (NHAs): Sites of special interest for their fauna or flora. NHAs are included in the Rural Environment Protection Scheme (REPS).

Natural Pollutant: A substance of natural origin that may be regarded as a pollutant when present in excess (e.g. volcanic dust, particles of sea salt, products of forest fires).

Nitrate (NO₃): A salt of nitric acid (HNO₃).

Nitrogen Fixation: Any reaction as a result of which gaseous nitrogen forms a soluble compound that is available as a plant nutrient either directly or after it has engaged in further reactions.

Nitrogen Oxides (NO_x): Usually includes the two pollutants nitric oxide (NO) and nitrogen dioxide (NO₂) produced by high temperature combustion and some natural processes. NO₂ is the most important form which can contribute to adverse health effects, ozone formation and acid deposition.

Nutrient: Element or chemical essential for growth, e.g., phosphorus, nitrogen, silica, oxygen and carbon.

Organochlorine (Chlorinated Hydrocarbon): An organic compound containing chlorine. Many organochlorines have biocidal properties and are used as the active ingredients for pesticides with a high persistence, which they derive from their chemical stability and low solubility in water.

Oxidation-Reduction: Chemical reaction involving the transfer of electrons from one chemical species to another. The species from which the electrons are lost is said to be 'oxidised' and the species to which the electrons are transferred is said to be 'reduced'. Compounds which undergo reduction readily, such as molecular oxygen, are called oxidising agents or oxidants.

Ozone (O₃): A secondary pollutant in which the molecule of oxygen consists of three atoms rather than two.

Ozone Layer: A layer of the atmosphere, over 20 km above the Earth's surface, in which the concentration of ozone is higher than it is elsewhere in the atmosphere owing to its accumulation through vertical air movements from a higher altitude, where it forms by the dissociation and reformation of oxygen molecules exposed to high frequency ultraviolet radiation.

PCBs (Polychlorinated Biphenyls): A group of closely-related organochlorines the principal use of which has been as liquid insulators in high-voltage transformers.

Pelagic: Describes organisms which inhabit the open water of a sea or lake in contrast to the sea or lake bed.

Pesticide: A general term for any chemical agent which is used in order to kill unwanted plants ('weeds'), animal pests, or disease causing fungi.

pH: The measure of the acidity or alkalinity of a substance.

Phosphate (PO₄): The commonly occurring form of phosphorus taken up by plants in the aquatic environment and essential for their growth.

Photochemical Smog: A characteristic, mainly of urban atmospheres, associated with the build up of primary pollutants and photochemical oxidants usually under slow moving, warm, high pressure systems.

Phycotoxin: A compound, toxic to humans and animals, produced by some phytoplankton groups, particularly dinoflagellates, and by cyanobacteria.

Phytoplankton: Microscopically small plants which float or swim weakly in fresh or salt water bodies.

Plankton: Organisms suspended in water by currents, the presence of air sacks or by their own swimming movement. Phytoplankton refers to microscopic plants, and zooplankton refers to microscopic animals.

PM₁₀: Particulate matter measuring less than 10 microns in diameter.

Pollution: The direct or indirect alteration of the physical, chemical, thermal, biological, or radioactive properties of any part of the environment in such a way as to create a hazard or potential hazard to the health, safety, or welfare of living species.

PVC (Polyvinylchloride): One of the most common plastics, used in the manufacture of clothing, furniture, and containers.

Population Equivalent: The organic biodegradable waste load having a five day biochemical oxygen demand (BOD₅) of 60 grams of oxygen per day is defined as one population equivalent (i.e., the amount produced by one person) in the urban waste water treatment Directive.

Precipitation: The manner by which water and other matter in the atmosphere reach the earth's surface. Wet precipitation includes rainfall, snow, hail, mist and fog. Dry precipitation describes the deposition of gases, aerosols and particles not dissolved in atmospheric borne water.

Primary Pollutant: A pollutant which is emitted directly into air or water.

Radon: An element occurring naturally as a colourless, odourless, noble gas, chemically almost inert, which is the immediate breakdown product of radium-226.

Raised Bog: An area of ombrogenous (i.e., originating as a result of wet climates) acid peatland with a convex profile.

Renewable Resource: A resource that can be exploited without depletion because it is constantly replenished, e.g., solar radiation and wind.

Salmonid Waters: High quality waters suitable for the maintenance of viable self-sustaining populations of wild salmon and trout.

Saxitoxin: A type of toxin produced by dinoflagellates which accumulates in mussels and can cause paralytic shellfish poisoning in humans.

Secondary Pollutant: A pollutant created through interactions between primary pollutants and various other components.

Sewage: Liquid wastes from communities, conveyed in sewers. Sewage may be a mixture of domestic sewage effluents from residential areas and industrial liquid waste.

Sewage Sludge: Semi-solid and solid waste matter removed from sewage at sewage treatment plants.

Sewerage: A network of pipes and associated equipment for the collection and transportation of sewage.

Silage: A farm livestock feed made from mown grass or other suitable herbage, which is compressed and partly fermented anaerobically.

Sludge: The suspended matter in industrial effluent or sewage remaining after partial drying.

Slurry: The animal waste generated in animal housing units that have slatted floors and in which there is no use made of bedding material.

Sulphate (SO₄): A constituent of rain and acid aerosols produced by oxidation of SO₂ in the atmosphere.

Sulphur Dioxide (SO₂): A colourless gas produced mainly by oxidising the sulphur in fossil fuels through combustion.

Sustainable Development: Defined by the Bruntland Commission (1987) as 'development that meets the needs of the present without compromising the ability of the future generations to meet their own needs'.

Synoptic Weather Station: A meteorological station at which a variety of meteorological information for a given area at a particular time is recorded (e.g., air temperature, wind speed and direction and pressure).

Tailings: Those portions of washed ore that are considered too poor to be treated further.

Trace Element: An element which is necessary in extremely small amounts for the proper functioning of metabolism in plants or animals.

Trophic State: The extent of enrichment of a waterbody as assessed by the nutrient concentrations, amount of planktonic algae and macrophytes, water transparency and oxygen levels. The trophic categories oligotrophic, mesotrophic, eutrophic and hypertrophic are used to describe waters varying from un-enriched to highly enriched.

Turlough: A temporary shallow lake in limestone country which fills and empties through cracks in response to the local water table.

Volatile Organic Compounds (VOC): Organic compounds which evaporate readily and contribute to air pollution mainly through the production of secondary pollutants such as ozone.

Waste Arisings: A measure of the amount of waste generated by a specified sector or activity.

Wetland: An area covered permanently, occasionally, or periodically by fresh or salt water (e.g., flooded pasture land, marshland, inland lakes, rivers and their estuaries); also includes bogs.

Wildfowl Sanctuaries: Areas of importance for bird life where the shooting of traditional game bird species is prohibited under the Wildlife Act 1976.

98-percentile Value: The value of a ranked distribution above (or below) which 98 per cent of values in the distribution lie, depending on application.



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Environmental Protection Agency
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