

FRESHWATER TAMAR AND TRIBUTARIES CATCHMENT MANAGEMENT PLAN CONSULTATION REPORT



NRA

*National Rivers Authority
South Western Region
September 1995*

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Published September 1995



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Foreword

The National Rivers Authority has, since its formation in 1989, been developing the process of catchment management.

A major initiative is the commitment to produce Catchment Management Plans setting out the Authority's vision for realising the potential of each local water environment.

The Freshwater Tamar and Tributaries is the second Catchment Management Plan (CMP) produced by the Cornwall Area of the National Rivers Authority (NRA). CMPs will be produced for all catchments in England and Wales by the end of 1998.

An important stage in the production of the plans is a period of public consultation. The NRA is keen to draw on the expertise and interest of the local communities and for them to have a say in the development of NRA plans and work programmes.

This document includes relevant information about the catchment and lists the issues we have identified and which need to be addressed. Please send us your comments, your views are important.

Following the public consultation period, an Action Plan will be produced with an agreed costed action programme for the future protection and enhancement of this important catchment.

Please send your comments by 6 November 1995 to:

Darragh Turley
Area Catchment Planner - Cornwall Area
NRA South Western Region
Sir John Moore House
Victoria Square, Bodmin
Cornwall, PL31 1EB

We look forward to hearing from you.



ROB ROBINSON
AREA MANAGER (CORNWALL)

MISSION AND AIMS

"We will protect and improve the water environment by the effective management of water resources and by substantial reductions in pollution. We will aim to provide effective defence for people and property against flooding from rivers and the sea. In discharging our duties we will operate openly and balance the interests of all who benefit from and use rivers, groundwaters, estuaries, and coastal waters. We will be businesslike, efficient and caring towards our employees."

Our aims are to:

- * Achieve a continuing overall improvement in the quality of rivers, estuaries, and coastal waters, through the control of pollution.
- * Manage water resources to achieve the right balance between the needs of the environment and those of the abstractors.
- * Provide effective defence for people and property against flooding from rivers and the sea.
- * Provide adequate arrangements for flood forecasting and warning.
- * Maintain, improve and develop fisheries.
- * Develop the amenity and recreational potential of inland and coastal waters and associated lands.
- * Conserve and enhance wildlife, landscape, and archaeological features associated with inland and coastal waters of England and Wales.
- * Improve and maintain inland waters and their facilities for use by the public where the NRA is the navigation authority.
- * Ensure that dischargers pay the costs of the consequences of their discharges, and as far as possible, to recover the costs of water environment improvements from those who benefit.
- * Improve public understanding of the water environment and the NRA's work.
- * Improve efficiency in the exercise of the NRA's functions and to provide challenge and opportunity for employees and show concern for their welfare.

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1.0 CATCHMENT VISION

The Freshwater Tamar and Tributaries Catchment is largely rural in character and sparsely populated outside of the main centres of Launceston and Holsworthy. The landscape is dominated by traditional rural industries, principally agriculture, but also forestry, quarrying and mining, and more recently tourism. In the last six years through efforts by the NRA, the farming community and the Water Company, water quality has significantly improved. However, further localized improvements are possible together with a further reduction in pollution incidents through minimizing risk.

The catchment is regionally important as a source of public water supply. The centrepiece of the system is Roadford Reservoir which has been built to meet the rising demands for water well into the 21st century.

The flooding of people and property other than agricultural land is not particularly significant, however local threats can arise.

The catchment contains a variety of river type and environment which is acknowledged nationally for landscape and conservation values. It also contains nationally important habitats and species. The otter population has increased within the catchment in recent years and must be considered a real conservation success. However, other habitats and species, especially Culm grassland and associated species, have been in decline.

Further improvements will therefore be required to achieve environmental sustainability. Changes in land use and the demands for development will also need to be taken into account. Key NRA objectives will therefore include:

- * Maintenance of high water quality standards with improvements on some sections. Further reductions in pollution incidents and risk, particularly agricultural.
- * Ensuring the efficient and prudent use of abstracted water in order to protect the environment and reduce the need for development of additional sources.
- * Ensuring that the salmonid fishery fulfils its environmental potential.
- * Conservation, and where appropriate, enhancement, of the natural river channel and related habitats. Conservation and restoration of wetlands, particularly Culm grassland.
- * To increase enjoyment and appreciation of the water environment.
- * Minimizing the risk to people and property from flooding.
- * Maintenance of the natural hydrological cycle, including natural river and wetland functions and processes.
- * Maintenance, and where appropriate, enhancement of the biodiversity of aquatic and wetland habitats and species.

It is important to recognize that established partnerships need to be reinforced and new areas of co-operation developed. The NRA will work with other Agencies and local representatives to promote and achieve integrated management of the catchment.

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Map 1 - Freshwater Tamar Catchment



2.0 INTRODUCTION

Catchment Management Plans

Sustainable development can be defined as *development that meets the needs of the present without compromising the ability of future generations to meet their own needs*, and it is at the heart of UK policy on the environment. A recent government publication, Sustainable Development - The UK Strategy (HMSO 1994), recognizes the inland freshwaters of the UK as *a vital and highly valued component of the UK environment and ecology*, along with the conflicts that may arise between different purposes and uses of the water and water environment.

A holistic approach to river management is required to plan for environmental sustainability and improvement. To this end, the NRA has developed the concept of Catchment Management Plans (CMPs). These allow the full range of water management issues to be identified and considered within a geographical area which is both relevant and meaningful. CMPs are strategic in nature, since individual catchments cover large areas of land often straddling local authority boundaries.

The Consultation Report

This Consultation Report includes the following sections :

Catchment Characteristics, which provides a brief and general introduction to the catchment describing its key characteristics.

Catchment Uses, which describes the activities that take place in the catchment which may influence the water environment or have requirements of it. We include notes about our role in managing or promoting these issues.

Catchment Status, where we assess the state of the catchment in relation to the water environment, and identify environmental quality targets where we can.

Issues and Options, where we identify situations where targets are not being met or we are failing to meet our objectives. Where possible we identify options and invite comment on the possible course of action to resolve the issues.

Your Views

This Consultation Report is our initial view of the issues facing the catchment. We hope that this report will be read by everyone who has an interest in the catchment and we would welcome your ideas on its future management.

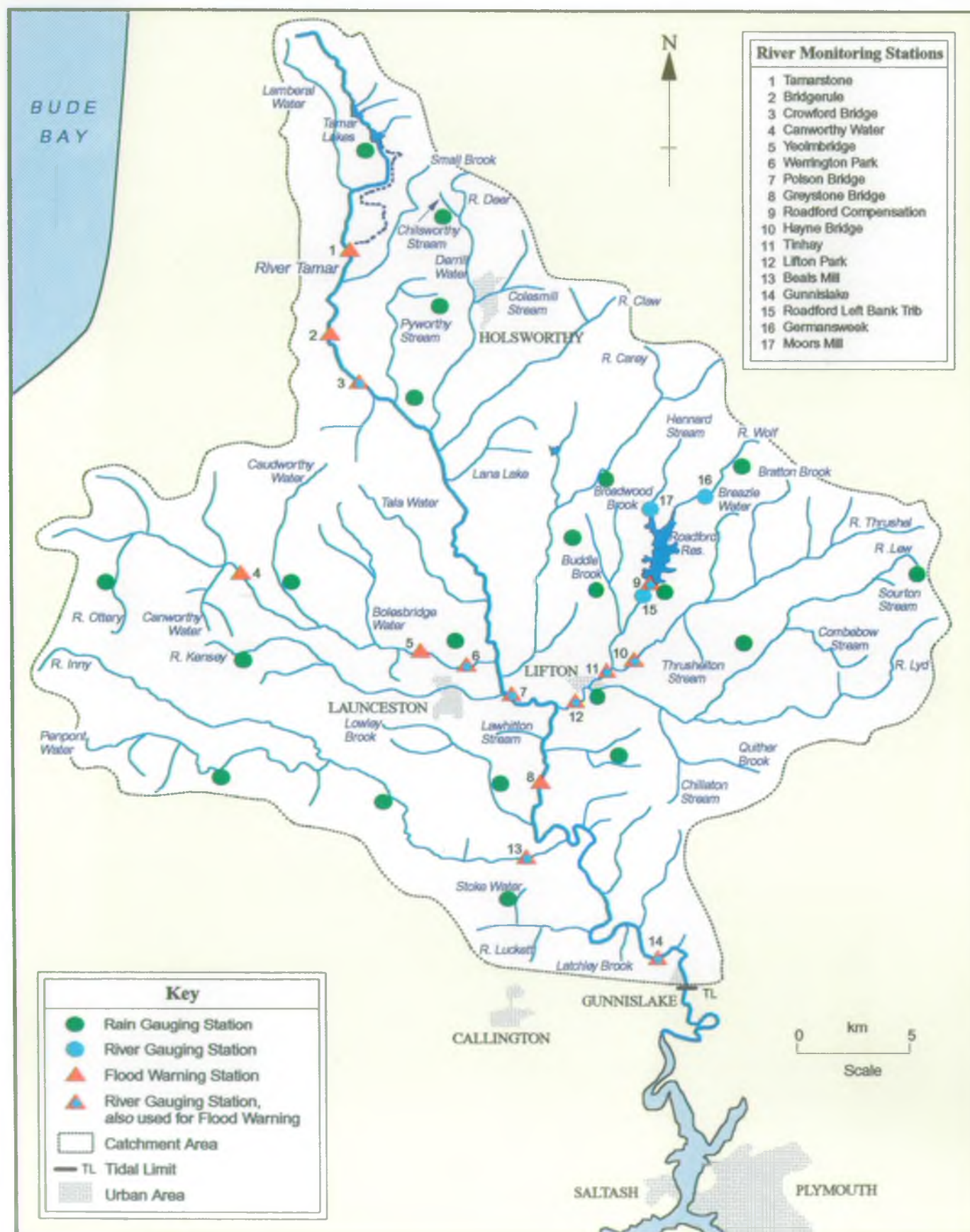
- * Have we identified all the issues ?
- * Do you agree with the River Quality Objectives proposed?
- * Have we identified all the options for solutions ?
- * Have you any comments on the issues and options listed ?
- * Do you have any other information or ideas which you would like to bring to our attention?

Action Plan

We will collate the responses to this report and publish an Action Plan in March 1996. This will contain costed and timetabled actions for the following 5 years. The Action Plan will be reviewed annually and a progress report published. The Plan will normally be subject to a major review every 5 years.

A Steering Group has been set up comprising representatives of organisations and individuals representing interest groups in the catchment. They have helped us produce this Report, and will monitor our progress with the Actions.

Map 2 - Hydrometric Network



2.1 CATCHMENT STATISTICS

Catchment Area :	927.75 km ²
Population:	32,900 (1991 Census)
Length of Main River:	167.05 km
Length of Controlled Water:	447.90 km

Long Term Average (LTA) annual whole rainfall over the catchment (1961-90): 1190mm

Principal Towns:	Launceston, Holsworthy
District Councils:	North Cornwall District Council, Torridge District Council West Devon Borough Council, Caradon District Council

Drainage areas

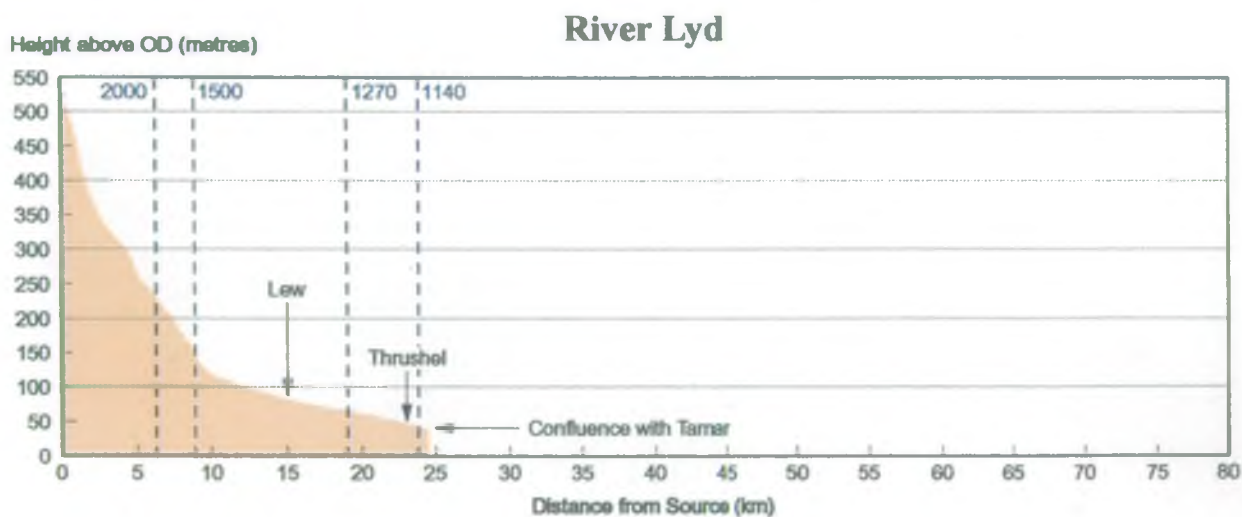
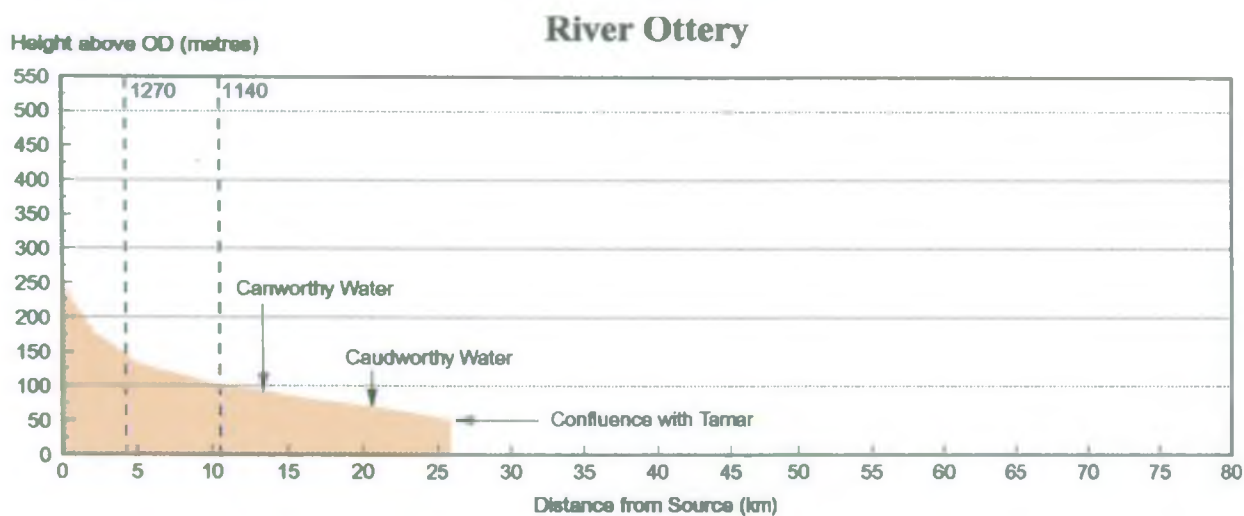
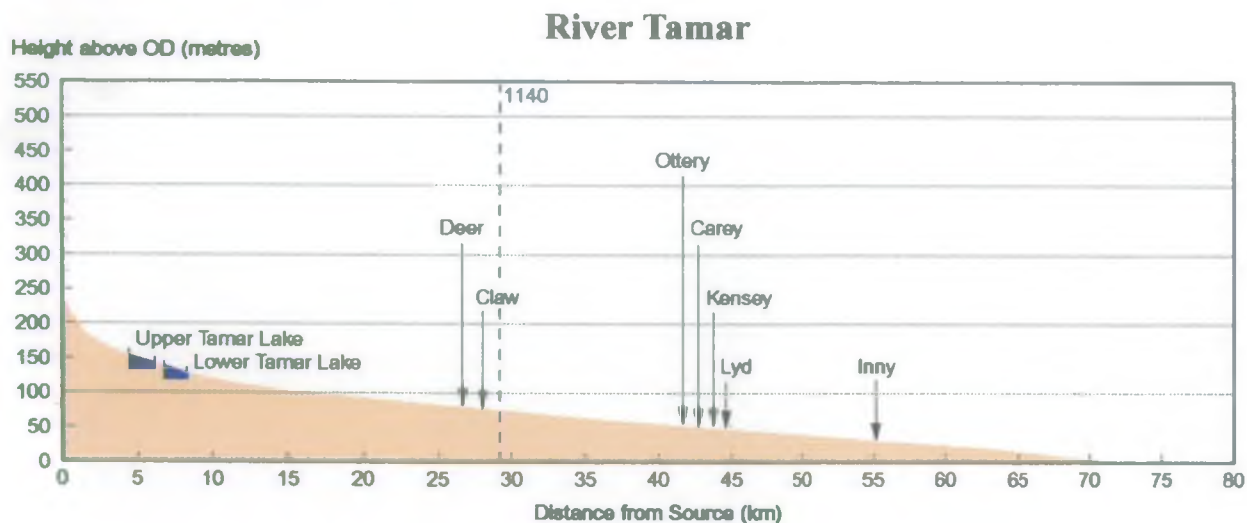
River	Area drained upstream of:	Area drained (km ²)	Length of named river (km)
Carey	Tamar Confluence	68.0	21.5
Thrushel	Lyd Confluence	116.5	21.4
Lyd	Tamar Confluence	105.0	25.2
Ottery	Tamar Confluence	124.5	33.0
Kensey	Tamar Confluence	38.5	16.8
Inny	Tamar Confluence	108.25	32.5
Deer }	Tamar Confluence	81.75	16.8
Claw }			12.1
Tamar	Gunnislake Weir	927.75	78.0

The NRA hydrometric network is shown on Map 2. The 12 river gauging stations take river level/flow measurements every 15 minutes. Average flows, catchment areas and length of records at the gauging stations are shown in Table 1. In addition to the gauging stations, data exists from spot measurements taken at 63 locations throughout the catchment. A network of 21 rain-gauges provide good coverage of the Tamar Catchment (see Map 2). Annual rainfall totals at rain-gauge sites vary from 930 mm to 1581 mm (1961-90 LTA) within the catchment. There are no groundwater monitoring sites within the catchment.

Table 1: Hydrometric gauging stations

Station	River	NGR	Start Date	Catchment Area (km ²)	Gauged Average Daily Flow
Beals Mill	Inny	SX 3589 7706	11.10.1988	105.0	3.115
Crowford Bridge	Tamar	SX 2905 9910	21.06.1972	76.7	2.479
Germansweek	Wolf	SX 4458 9422	27.08.1991	11.0	0.281
Gunnislake	Tamar	SX 4263 7252	26.06.1956	916.9	22.235
Hayne Bridge	Thrushel	SX 4160 8670	01.08.1988	58.4	1.262
Lifton Park	Lyd	SX 3888 8424	19.02.1988	218.1	4.716
Moors Mill	Hennard Stream	SX 4245 9385	07.04.1991	7.2	0.174
Polson Bridge	Tamar	SX 3530 8490	22.12.1987	470.3	9.591
Roadford Compensation	Wolf	SX 4190 8980	31.03.1988	31.1	0.467
Roadford LB Tributary	Trib to Wolf	SX 4190 8975	03.06.1986	0.3	0.005
Tinhay	Thrushel	SX 3976 8549	01.10.1969	112.7	2.351
Werrington Park	Ottery	SX 3374 8658	25.06.1985	120.7	2.808

Figure 1 - River Profiles



Key	
1140	Annual Rainfall
---	Long Term Average (1940-1970)

3.0 CATCHMENT CHARACTERISTICS

3.1 Introduction

The River Tamar Catchment extends from the south coast of the peninsula to within 10 km of the north coast. The River Tamar itself forms a natural boundary between the counties of Devon and Cornwall. The catchment drains 927.75 km².

The River Tamar rises in the north of the catchment approximately 10 km north east of Bude and flows south through a broadening floodplain to a point south east of Launceston. This part of the catchment consists of broad areas of gently undulating or relatively level land with a fairly wide level valley floor. The river then flows through a steep sided valley in a series of incised meanders which become more pronounced towards the tidal limit at Gunnislake Weir, 78 km from its source. This plan will be followed by the Tamar Estuary and Tributaries Plan, the boundary of which will run up to Gunnislake Weir. Both plans will be integrated and once complete could be read as one.

Population

The population of the catchment is approximately 32,900 (1991 Census) and is mainly rural in character. Major settlements within the catchment are Launceston, Holsworthy and Gunnislake at the tidal limit of the River Tamar.

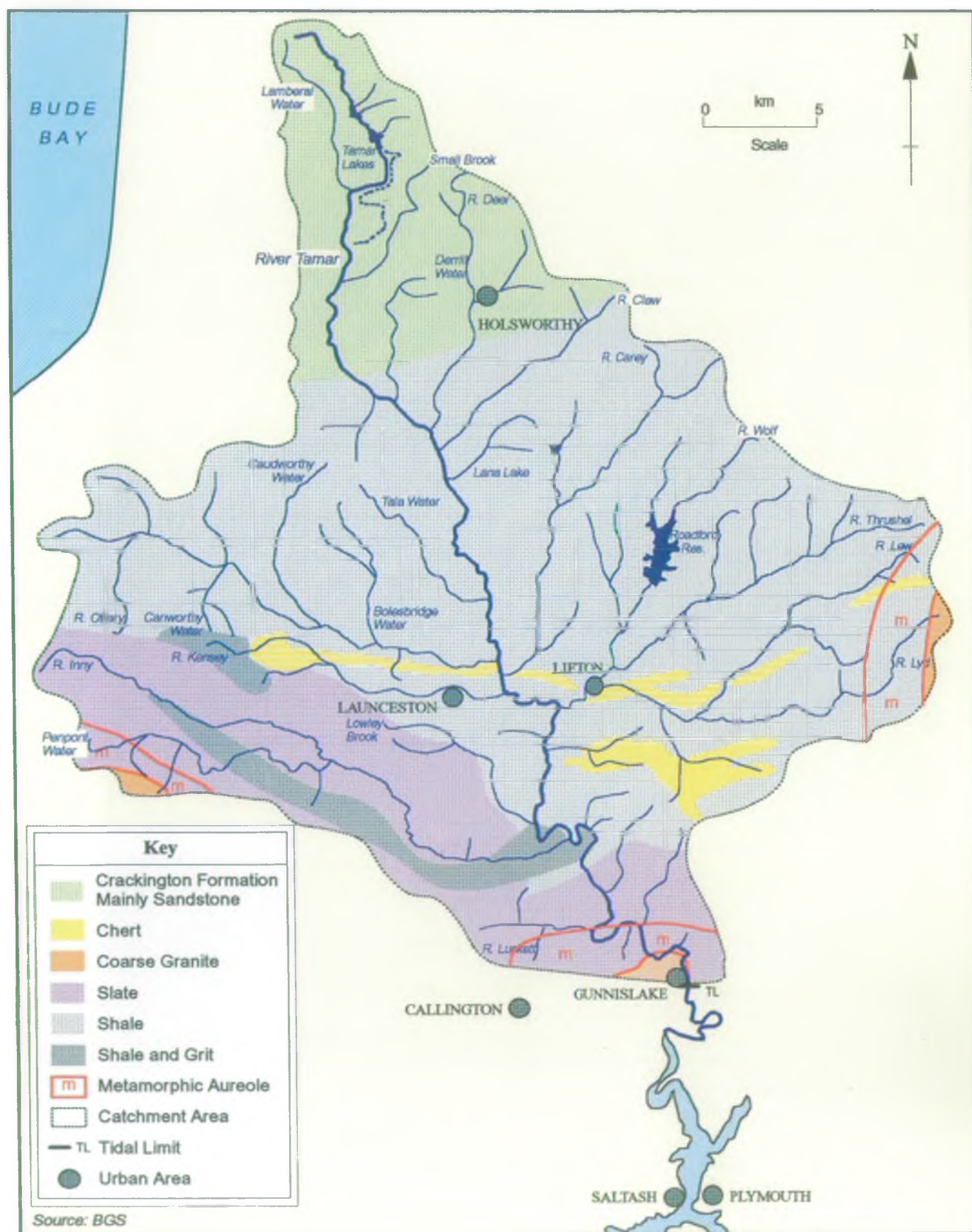
Population Statistics

Subcatchment		Population Census		% Change
		1981	1991	
12J	Upper Tamar	5853	6605	+13%
12F	Lyd	2175	2350	+8%
12G	Thrushel & Wolf	1844	1952	+6%
12H	Carey	2007	2475	+23%
12M	Ottery	2140	2450	+14%
12N	Kensey	7045	7680	+9%
12P	Inny	2190	2505	+14%
12E	Lower Tamar	5577	6860	+23%
Total		28831	32877	+14%

Source: Cornwall County Council/Devon County Council

The largest population increases between the 1981 and 1991 Census occurred in those parishes that include the larger settlements or rural parishes that have close links with larger towns. The sparsely populated rural parishes showed either a small increase or a decrease in population. The population growth in West Devon parishes is considered by the Borough Council to be solely through in-migration.

Map 3 - Geology



CATCHMENT CHARACTERISTICS

Geology and Mineralisation

Most of the rocks of the Tamar catchment are hard mudstones, shales, siltstones, sandstones and minor limestones which have been subjected to extensive fissuring and faulting. The granitic mass of Dartmoor, which touches the eastern border of the catchment, was intruded into the folded and faulted rocks at the end of the Carboniferous period some 300 million years ago. A short-lived volcanic phase followed.

Intense tin/copper/arsenic and, locally, tungsten mineralisation is found associated with the granite mass. The trend of the mineralised lodes is predominantly east-west and can be observed in the Gunnislake-Kit Hill-Callington-Hingston Down areas. Within these areas, and elsewhere in the catchment, lead/zinc/silver mineralisation is found but the trend of the lodes bearing these minerals is predominantly north-south. Manganese mineralisation is also present within the catchment and tends to be associated with chert and volcanic deposits.

The geology of the catchment impacts on the water environment in a number of ways: the physical composition such as landform, soils, groundwater storage, surface water flow patterns and natural chemical composition of water. The exploitation of the mineralised areas has also left a legacy, see Sections 4.10, 4.11 and 5.1.

Hydrogeology

The rocks underlying the Tamar Catchment, while of differing origins, have low permeability and porosity, limiting groundwater flow and storage. The widespread folding and faulting that the rocks have been subjected to have resulted in fractures and fissures, where most storage and groundwater movement occurs. Although weathering and other processes (such as soil creep (movement) down valley sides) have opened up the rock structure enhancing groundwater storage and permeability near the surface, overall groundwater storage remains low. The limited groundwater flows are generally restricted to shallower depths, with water levels reflecting the topography and local drainage pathways. Along river valley floodplains alluvial deposits provide additional groundwater resources.

Local groundwater storage can be significantly altered where historic mining has occurred. The associated mine drainage systems can cause significant flows over large distances and in some cases into adjacent catchments. The course of such pathways often cannot be determined with any certainty on account of poor mining records, though the sites of some adit portals are known (see Section 4.9).

The primary groundwater uses within the catchment are to support baseflows in rivers and numerous small-scale water supplies. These are highly vulnerable to contamination from pollutants where soils are shallow due to low porosity and rapid flow within the fracture systems.

Soils

The nature of soils have a significant impact on land use, the degree of protection to groundwater and surface water quality, particularly during and after flood events. There are three dominant soil types found in the catchment. These are formed through the differing weathering of parent materials (rocks) and hydrological conditions, both of which are outlined above. A detailed soils map has been published by The Soil Survey¹. Characteristics of the three main soil types and their influence on the water environment are summarized on page 11.

RIVER TAMAR AT GUNNISLAKE

1976

1984

1989

Prescribed flow = 5.523 m³/s

ADF = 22.495 m³/s

Q95 = 1.863 m³/s

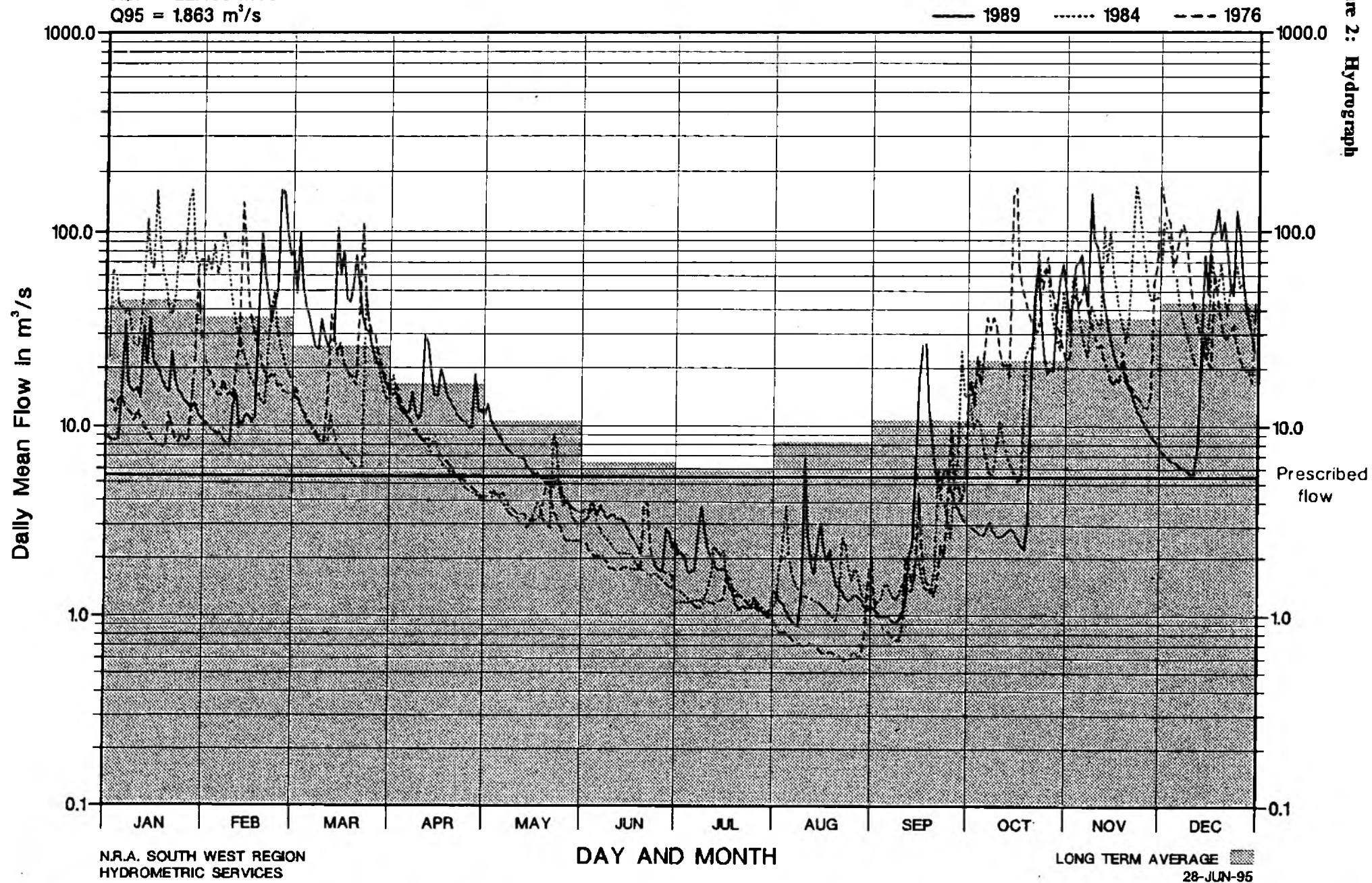


Figure 2: Hydrograph

CATCHMENT CHARACTERISTICS

CHARACTERISTIC	SOIL TYPE		
	Brown Earths	Brown podzolic soils	Surface-water gley soils
DIRECTION OF WATER MOVEMENT	Vertical percolation but some localised and seasonal, lateral flow	Vertical percolation	Lateral runoff except in very dry weather, then by-pass flow to shallow depth
SOIL WATER STORAGE CAPACITY (Average days/year spare capacity)	Well drained, moderate storage capacity. (160-210 days)	Well drained, moderate storage capacity. (160-200 days)	Waterlogged from autumn until early summer, slight storage capacity. (35 days)
STREAM RESPONSE TO RAINFALL	Slight	Muted	Immediate
GROUNDWATER VULNERABILITY CLASS	Intermediate leaching potential.	Intermediate leaching potential.	Low leaching potential.
LAND DRAINAGE	Little or none	None	Widely drained.
AGRICULTURAL USE	Readily cultivated and trafficked. Arable and grass ley	Too steep for cultivation. Pasture, rough grazing.	Permanent pasture, moor, wet rough grazing, scrub. Trafficability difficult October to April
OLD PERMANENT GRASS	Mixed species grass with bracken and gorse	Mixed species grass with bracken and gorse	Culm grassland with <i>Molinia</i> and locally heath
ORGANIC WASTE AND EFFLUENT DISPOSAL			
Season	Long	Long (but slope dependant)	Very short
Runoff risk	Small	Small (but slope dependant)	Large. Also risk in dry weather from crack by-pass
BOD Amelioration	Large	Large	Slight
Excavated Stores, Soakaways etc	Little water to pollute but basal Head gives route for added liquid	Little water to pollute but basal Head gives route for added liquid	Much water in basal Head ready to be polluted

The above summary table highlights some of the soil characteristics which dictate land use and the potential impact on the water environment. Within the Tamar this is particularly agriculture, see 4.3.

RIVER TAMAR AT GUNNISLAKE

FLOW DURATION CURVE 1957-1994

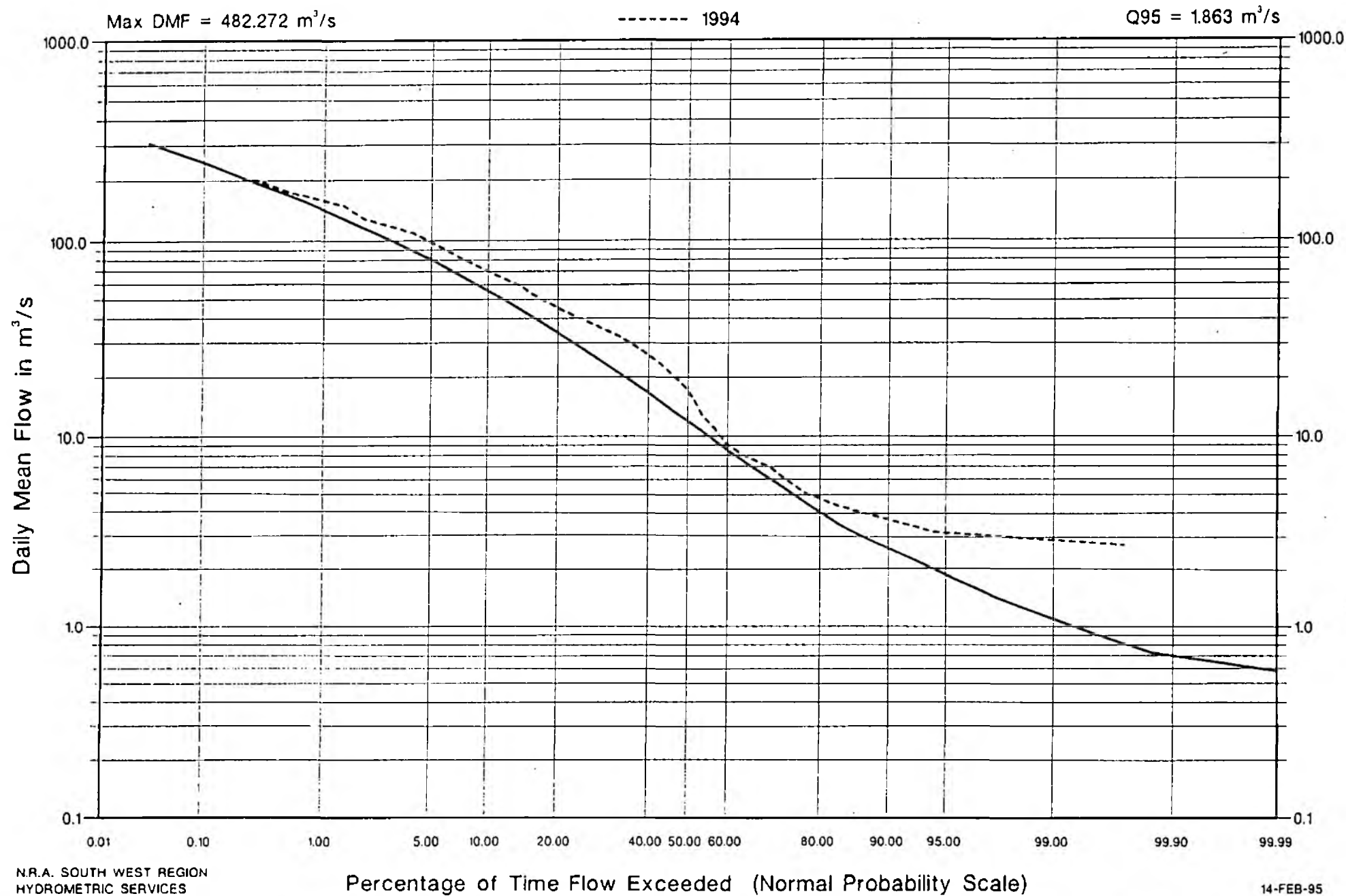


Figure 3: Flow Duration Curve

CATCHMENT CHARACTERISTICS

Hydrology

The River Tamar is one of the biggest rivers in the South West with average annual runoff of 22.495 m³/sec over the period from 1957 to 1993. However, this figure conceals major variations in runoff from month to month. Highest flows are usually recorded in either December or January when the water table is near the ground surface. The maximum recorded daily mean flow at Gunnislake, 482.272 m³/s and the maximum instantaneous flow, 714.570 m³/s were recorded on 27th December 1979 and 28th December 1979 respectively.

River flows are measured at a number of gauging stations throughout the catchment (see Map 2). In Figure 3 data from Gunnislake gauging station is presented in the form of a flow duration curve. This shows the flow plotted against the percentage of time that flow value is exceeded. The shape of the curve reflects the influence of natural variables such as catchment geology and soils. The curve is relatively steep throughout its length because the underlying granite, slate and shale restrict groundwater storage whilst slowly permeable soils in the upper catchment promote rapid surface runoff. This characteristic is known as "flashy". (Note: For rivers where the response to rainfall is not so rapid, a flow duration curve would tend to be flatter).

Man has an increasingly significant impact on the river flow regime. Deforestation beginning in Neolithic times is likely to have had a significant impact. Reduced interception and evapotranspiration would have led to a greater proportion of rainfall contributing to river flow. In the eighteenth and nineteenth centuries water from the river powered the pumps that kept the mines dry and raised and crushed ore. Although the mines are now closed and the leats disused, water from the old mine workings still drains to the river via numerous adit discharges. Locally these discharges may benefit river flows during dry periods by sustaining groundwater flow.

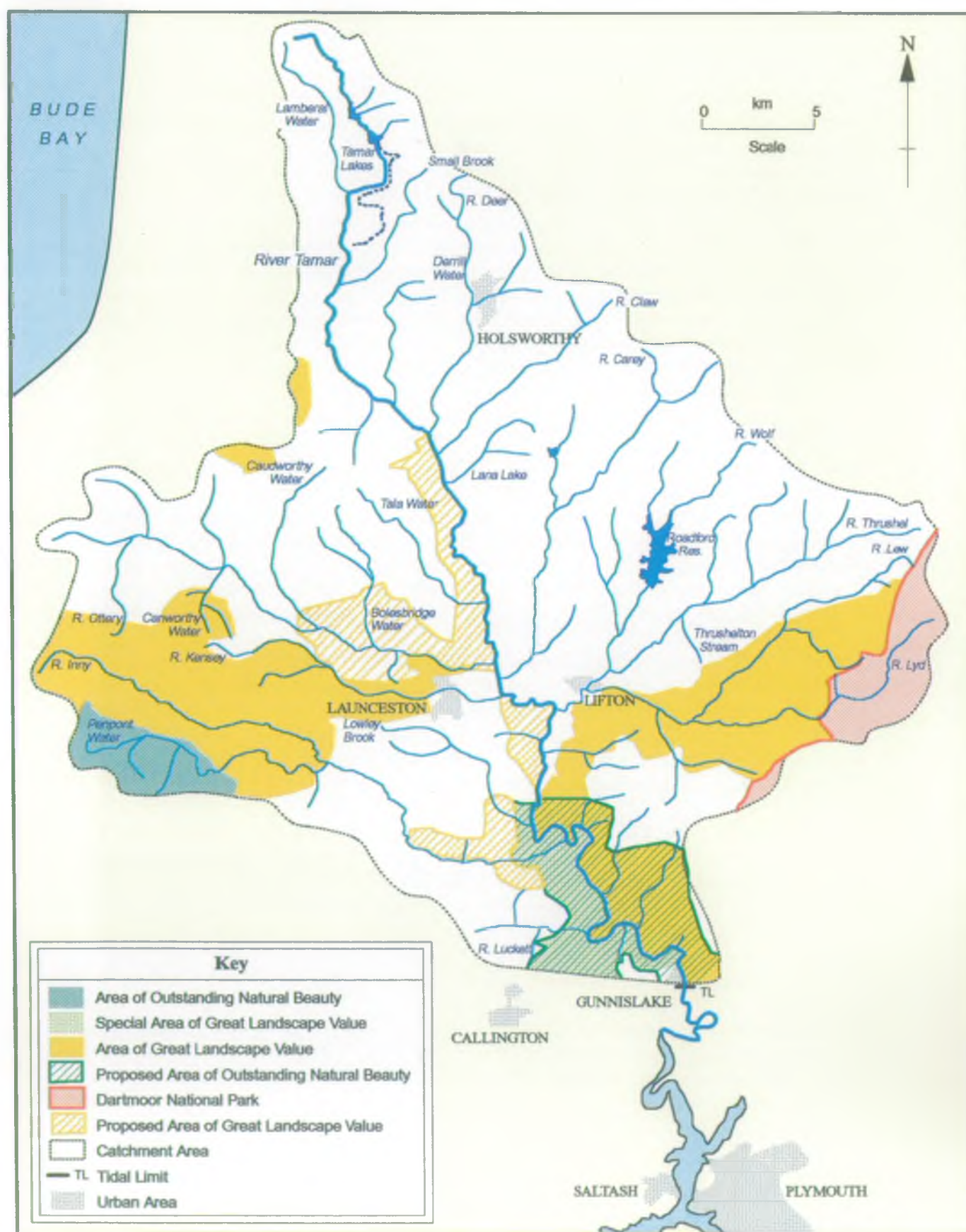
More recently the Tamar has been affected by the impoundment of Roadford Reservoir on the River Wolf. Roadford reduces the variability of flows on the rivers Wolf, Thrushel, Lyd and Tamar by storing water over the winter and releasing it during the summer. Releases are made to support a public water supply abstraction at Gunnislake. A compensation release of 0.104 m³/s must be made from the reservoir at all times. Releases include allowances (10%) to cover transmission losses, a matter under review by the NRA.

The lowest recorded flow at Gunnislake of 0.581 m³/s occurred on 23rd August 1976 after 5 months of very little rainfall and receding river levels. The 1976 drought was more severe and lasted longer than subsequent dry weather events in 1984 and 1989. Flows dropped below the Q95 value for 97 days in 1976, 82 days in 1984 and 59 days in 1989 (Figure 2).

Landscape, Wildlife and Archaeology

It is recognized that the landscape, wildlife and archaeology in all various forms throughout the catchment are an integral part of the catchment characteristics. For the purpose of this plan however, these characteristics are dealt with as a 'use' with a description of particular qualities which may require protection or enhancement through planned actions.

Map 4 - Landscape Designation



4.0 CATCHMENT USES

4.1 Conservation - Landscape, Wildlife and Archaeology

We consider here how we protect and manage the natural environment and the historic built environment associated with rivers and wetlands.

Our Objectives

To ensure that these features are not degraded through neglect, mismanagement, or insensitive development and wherever we can we take measures to enhance them.

The Role of the NRA

Legislation tells us what we can and can't do to regulate work in rivers and floodplains. An important part of our work is to influence land use planners and land managers to look after rivers and wetlands sensitively.

We have duties and powers to:

- * conserve and enhance landscape, wildlife and natural features especially in rivers and wetlands
- * protect and conserve buildings, sites and objects of archaeological, architectural or historic interest.

Our work involves a range of activities:

- * we study river and wetland wildlife and are developing better methods for doing this
- * we are developing standard ways of reviewing the effects of our work on wildlife
- * we are establishing a national database to store wildlife information
- * we are improving the way we consider and carry out Environmental Assessments
- * we encourage local planning authorities and developers to promote wildlife conservation on rivers and wetlands and we encourage the development of new river management techniques.

4.1.1 Landscape

Water has been fundamental in shaping the landform and dictating natural vegetation patterns. Human modifications of natural drainage systems and changing land use has been superimposed on these natural patterns. The resulting combination of semi-natural and managed land combines to create a landscape which is essentially pastoral in nature with little urbanisation.

Map 5 - Conservation Designations



CATCHMENT USES

Designated Areas (see Map 4)

National Park - A small part of Dartmoor National Park covers the extreme south east of this Plan area. National Parks are afforded special protection from development, overseen by National Park Authorities. Their broad objectives are to enhance the natural beauty of the landscape and to provide opportunities for appropriate recreation.

Areas of Outstanding Natural Beauty (AONB) - Parts of the Cornwall AONB (Bodmin Moor) and the proposed Tamar Valley AONB cover the south of the catchment. AONBs are landscapes of National significance, and are afforded special protection from development by Planning Authorities.

Special Areas of Great Landscape Value (SAGLV) and Areas of Great Landscape Value (AGLV) - These are County designations affording the areas protection in the County Structure Plan. SAGLVs are considered equivalent to AONBs and the proposed Tamar AONB is currently designated a SAGLV. A belt of land across the centre of the catchment and the area around Week St Mary are designated AGLVs. North Cornwall District Council has proposed three areas of the Tamar Valley between North Tamartown to Stoke Climsland as AGLVs.

4.1.2 Wildlife

The prime wildlife feature of the catchment is Culm grassland. Culm grasslands are wet, acidic pastures over clayey, poorly drained soils, supporting a wealth of different plants, invertebrates and birds. Nationally Culm grassland is restricted to this part of Devon and Cornwall, and is recognized as a priority habitat under the European Union Habitats Directive².

Significant areas of deciduous, coniferous and mixed woodland occur in the catchment. These display a wide age-range and management regime, so providing diverse wildlife habitats.

Moorland occurs on the south western (Bodmin Moor) and eastern (Dartmoor) sides of the catchment. The slopes and valleys contain areas of blanket bog, acid grassland, bracken, dry and wet heathland and scattered scrub. These two moorlands make up the major part of the uplands of southern Britain, supporting scarce plant, animal and bird populations more commonly found in Wales and the North of England.

Designated Areas

Proposed Special Areas of Conservation (SACs) - SACs are currently being proposed across the European Union member states to protect the habitats and species of prime conservation importance. In North Devon a candidate Culm grassland SAC has been put forward and includes Dunsdon Farm SSSI/NNR. North Dartmoor SSSI, a small part of which occurs in this plan area, is also proposed as a SAC due to the presence of blanket bog.

Sites of Special Scientific Interest (SSSIs) - SSSIs are recognized as nationally important sites, and are afforded specific protection through legislation. Within the catchment there are 19 SSSIs (see Appendix A). One of these, Dunsdon Farm, is a National Nature Reserve. Thirteen have some wetland or aquatic importance. Of these, 10 are Culm grassland sites worthy of the highest protection.

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Areas of Great Scientific Value (AGSV) - The south western fringes of the catchment lie within the Bodmin Moor AGSV. The AGSV designation is recognition that identified important sites such as SSSIs cannot be sustained effectively as isolated islands and seeks to provide (through the County Structure Plan³) buffer zones around sites, wildlife corridors to link sites, and emphasize the most important areas of nature conservation to concentrate resources.

Nature Conservation Zone (NCZ) - The eastern edge of the catchment lies within Dartmoor NCZ. This designation, like AGSVs, seeks to provide buffer zones around sites, wildlife corridors to link sites, and emphasize the most important areas for nature conservation to concentrate resources.

Cornwall Nature Conservation Sites (CNC sites) - In the Cornish part of the catchment there are 44 CNC sites. Although the reason for designation varies, many of the CNC sites are Culm grassland or valley woodland, in which the water environment is an essential component. Cornwall Nature Conservation sites are shown on Map 5. The names and grid references can be found in Appendix A.

CNC sites are notified by the Cornwall Wildlife Trust (CWT) as being representative of natural and semi-natural habitats found in the County and include SSSIs and National and Local Nature reserves. A number of others are owned and managed as nature reserves by various voluntary conservation organisations such as CWT and the Woodland Trust. Information on the sites is supplied to the County and District Councils who use the information to assess the impact of development proposals. The NRA also holds copies of the records for its own use and consults freely with the CWT.

Devon Wildlife Trust will complete similar designations in the Devon part of the catchment in early 1996. However, 'ad hoc' information exists for many sites and liaison between DWT and NRA takes place. When sites are defined in due course, the NRA will utilize and promote them wherever necessary.

Tamar Lakes CNC site supports a number of breeding water birds, such as Great Crested Grebe, Mallard, Coot and Canada Goose, and holds a significant wintering wildfowl community including Canada Goose (206), Teal (236), Mallard (178) and Pochard (63) (all figs. are average annual peaks from the last 5 years, except Pochard, 4 years).

The northern end of Roadford Lake is a Nature Protection Zone and recreation is prohibited. Some of the more notable maximum counts of wintering waterfowl include Widgeon (592), Teal (650), Mallard (495), Pochard (204), Tufted Duck (129) and Goldeneye (51). Great Crested Grebe breed here and a count of 68 in July 1992 included 16 young.

Rare and threatened species

A number of vulnerable wetland species live within the catchment. These include Otter, Marsh Fritillary, Kingfisher, Sand Martin, Dipper, Curlew and Snipe. The catchment has nationally important colonies of mosses, liverworts and lichens (see section 5.3).

4.1.3 Archaeology

Given the historic developments within the catchment there are likely to be numerous sites of interest which are not designated. The Cornwall Archaeological Unit (CAU) and Devon Archaeological Unit (DAU) have an ongoing programme (the Sites and Monuments Record) to catalogue such sites. The NRA will liaise closely with such groups.

It has been identified that there is not enough detailed information on the archaeological resource within the catchment ('Taking the Tamar Valley Towards the Year 2000'⁴, and conversations with County archaeologists and Dartmoor National Park) though the Duchy of Cornwall have carried out an assessment on their holdings.

There are a range of designated sites within the catchment, though few are closely related to the water environment. Given this, it is felt inappropriate that the NRA should take the lead in surveying the resource, however, we could collaborate.

Designated Sites

Scheduled Ancient Monuments (SAMs) - There are numerous SAMs within the catchment, with notable concentrations occurring on Bodmin Moor and Dartmoor. There are 13 bridges, designated as SAMs, which are of particular relevance to the NRA. SAMs are of national importance, protected in law and administered by English Heritage. They are given full consideration by the NRA in any relevant applications.

Area of Great Historic Value (AGHV) - A large part of Bodmin Moor is designated as an AGHV by Cornwall County Council, recognition of the concentration of archaeological interest.

Special Historic Area - Werrington Park, straddling the lower reaches of the River Ottery, has been designated a SHA by North Cornwall District Council.

Historic Settlements - There are 2 Historic settlements, Launceston and Lydford, of county importance for archaeological value above and below ground. With the AGHV they are afforded special protection in the Cornwall and Devon County Structure Plans.

Listed Buildings - There are numerous listed buildings within the catchment which are considered of county importance. Records are kept by District and County Councils and protection is offered through the planning system.

The NRA checks that any "in-house" developments or operations do not impact on listed buildings. Due to the number of listed buildings within the catchment applicants seeking NRA licences to undertake abstractions, discharges or works, are required to carry out their own search.

Map 6 - Fisheries



4.2 Fisheries

This use relates to the conservation of fish species, the maintenance and development of their environment and the exploitation of stocks.

Our Objective: To maintain, improve and develop fisheries.

The Role of the NRA

We have duties and powers to:

- * regulate fishing through a licensing system
- * police the illegal taking of fish and the sale and export of wild salmon and trout
- * ensure the unobstructed migration of salmon, sea trout and eels between the sea and their spawning grounds
- * monitor fish stocks
- * control the movement and introduction of fish or spawn into any waters other than fish farms
- * control fish disease outside fish farms
- * raise income through duties on fishing licences
- * ensure adequate levels of water to support fisheries
- * ensure suitable water quality through the EC Freshwater Fish Directive and Water Quality Objectives.

We are involved in a range of activities:

- * liaison with other organisations with a role to play in the protection and management of inland and coastal fisheries
- * maintaining effective links with local authority planning departments to ensure fisheries are not adversely affected by development plans
- * prevention or limitation of fish losses by implementing emergency and rescue policies
- * controlling the movement or introduction of fish or spawn into fish farms through liaison with the Ministry of Agriculture, Fisheries and Food (MAFF)

4.2.1 Local Perspective

The River Tamar supports a major game fishery for Atlantic salmon, sea trout and brown trout from the upper reaches of the estuary to its headwaters and those of its tributaries.

Fish Populations

Fish are good indicators of the overall health of our rivers. Information from routine population surveys, fish counters, fishing (rod and net) catch returns and fish traps are used to assess the health of fish populations.

Fisheries surveys have been carried out at various sites on the Tamar catchment since 1971. Eleven fish species with self-sustaining populations have been identified. The 1993 distribution of juvenile salmon and trout is shown on Map 6 (Note: the fishery may extend further than indicated but due to a lack of confirmed records we do not mark as such, and un-named watercourses are not surveyed). The most widely distributed non-salmonids are eel, bullhead,

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stoneloach, minnow and brook lamprey. The Tamar holds small populations of grayling and dace. Sea lamprey are known to breed between Nether Bridge and Gunnislake Weir, and smelt spawn in the area upstream and downstream of Gunnislake Weir.

Although salmon spawn throughout much of the Tamar catchment the most important areas are on the River Ottery, River Lyd and River Inny. This is confirmed by juvenile surveys and redd count observations.

Key sea trout and brown trout spawning areas occur in the headwaters of the River Ottery, River Carey, River Kensey, River Lyd (mainly in the River Lew) and River Inny (mainly in the Penpont Water). Full details of the 1993 and previous juvenile survey results for the Tamar catchment are given in Appendix B.

Rod Catch data

Reported Tamar rod catches : 1954 - 1993

Atlantic salmon : Maximum	1169 (year 1980)	Minimum	163 (1961)
Sea Trout :	Max. 1105 (1981)	Min.	134 (1956)

The Tamar is one of the premier salmon fishing rivers in the Westcountry with the second highest average rod catch (Average 564) behind the River Exe. Grilse (salmon which have been at sea for only one winter) and two sea winter fish (2SW) form the majority of the adult salmon population with three sea winter and previous spawners being rare. Catches vary considerably and there is no obvious trend in total catches. One factor we have been unable to take into account (through insufficiently detailed data) is changing fishing effort by anglers. Monthly rod catches vary considerably, peaking any month between May and October. Drought conditions have a strong negative influence on rod catches largely by inhibiting adult salmon migration from salt water.

Although reported rod catches in recent years have been below average, initial reports for 1994 are encouraging.

Sea trout rod catches on the Tamar have increased from 1954 to 1988 (current Average 409) possibly as a result of a larger sea trout run and/or due to increased fishing effort. However catches since 1989 have been below the long term average. Peak monthly catches occur in July and August.

There is a commercial net fishery for salmon and sea trout in the Tamar Estuary. The net fishery has a variable impact on the freshwater fishery, however the subject will be dealt with fully in the forthcoming Tamar Estuary Catchment Management Plan. There is a salmonid rod fishery on the River Tamar which operates for some distance downstream of Gunnislake Weir.

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Fish Counter

A resistivity fish counter was installed at Gunnislake Weir in 1991. It became fully operational in July 1992 and video validation commenced in June 1993. Validation is continuing, but so far indicates that the counter is providing reliable data. Estimates of the numbers of salmon and sea trout recorded migrating upstream over the counter in 1993 and 1994 are as follows:

Table 2: Salmon and sea trout recorded at Gunnislake fish counter

Year	Salmon	Sea trout
1993*	3,519	6,464
1994	4,780	10,911

* Technical problems meant that the counter was unoperational for a proportion of time in 1993, therefore the 1993 estimate is affected and the actual numbers are probably higher

It should be noted that migrating salmonids can bypass the fish counter by using the Devon fish pass or by jumping the weir under high flows and on spring tides. Investigations into the proportion of fish passing through the fish counter are continuing.

Trends in abundance of particular stock components

Since the early 1970s the proportion of grilse to 2SW salmon has altered and there is currently a much higher proportion of grilse in the population. This change may be cyclical in the long term, climate dependant or may be related to fishing on the high seas strongly selecting multi-sea winter fish. The outbreak of Ulcerative Dermal Necrosis (UDN) in the early 1970s dramatically affected spring salmon survival. There has been a reduction in the declared catches of three sea winter salmon and previous spawners within the rod fishery.

Spring-running salmon stock are predominantly of the 2SW age group. Catches of spring fish (defined as caught before the 1st June in any year) have declined since the 1960s in both the rod and the net fisheries. Net catches of spring salmon have fallen from an average of 275 fish (period 1963 to 1981) to an average of 91 fish (period 1982 to 1992). Rod catches have fallen from an average of 186 fish (period 1969 to 1981) to an average of 88 fish (period (1982 to 1992).

A recent NRA report on Spring fish stocks in the rivers of Devon and Cornwall²⁷ demonstrated similar trends for all the major salmon rivers. Based on net catch data, the decline on the River Tamar was the fourth most serious after the Rivers Taw and Torridge, the River Exe and the River Tavy. Annual salmon scale reading of a significant proportion of the rod and net catch is required to follow any further changes in the components of the Tamar salmon stock.

Introductions and escapees

Still water lakes of the Tamar Catchment contain a variety of non-native fish species. In recent years increasing numbers of still water fisheries have been formed within the Tamar Catchment. Escaped fish cause the NRA concern as they may form breeding populations which compete with native species and may carry diseases which could have a major impact on native stocks.

Stocks of dace and grayling are self-sustaining although both are considered non-native to the Tamar. The dace stock may have originated from Lower Tamar Lake. 10,000 grayling fry and

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yearlings were introduced between 1899 and 1909 into the Tamar and have maintained themselves since at low densities.

Common bream, roach, perch, rudd and carp are very occasionally found and are probably escapees from Tamar Lakes. Regular trapping and fish surveys on the River Wolf and River Thrushel has produced records of pumpkinseed, perch, goldfish, green tench and a dead golden orfe. All these fish were considered to be escapees from coarse fisheries or private ponds. Rainbow trout have occasionally escaped into the Tamar system from enclosed waters. None were caught during the 1993 Tamar survey.

Acid Runoff

During the first spate after a period of drought in 1984 fish kills occurred in the headwaters of the River Ottery and the River Kensey. An investigation⁵ has linked the deaths to lowered pH and increased metal levels. Whilst these are identified as being natural in origin, (see 5.1) the impact on the fisheries interest may warrant mitigation measures to be taken. Some options have been highlighted in 5.1.

Obstructions

There are only two impassable obstructions in the Tamar Catchment, the dams at Roadford Reservoir (Lyd subcatchment) and Tamar Lakes (Upper Tamar). All other obstructions are deemed to be passable. However there is some concern over Virginstow Ford on the River Carey (SX 3710 9263) which may obstruct the free passage of fish at a variety of flows. It was perceived that a shingle bank at the confluence of the River Inny with the River Tamar caused an obstruction to migrating fish at times of low flow. However, during juvenile surveys in 1990 fresh adult salmon and sea-liced sea trout were found at survey sites on the River Inny during low water drought conditions. This suggests that the shingle bank does not impede the upstream migration of adult salmonids.

Poaching

Sporadic illegal river netting by organized gangs occurs from Gunnislake Weir to Launceston from April to September. Poaching of spawning fish from the upper reaches of all the Tamar tributaries occurs from November to January. In particular, snaring and netting of fish from the River Lyd occurs from April to October. In addition, illegal rod fishing out of season takes place on the Rivers Lyd, Lew, Carey and main River Tamar.

Variable amounts of illegal netting occur in the Tamar Estuary. The impact on the freshwater fishery could be significant, however this will be dealt with fully in the forthcoming Tamar Estuary Catchment Management plan. Extensive day and night patrols by fisheries staff, wardens and fisheries assistants keep the impact of these activities to a minimum.

Legislative controls

It is a requirement of Section 25 of the Salmon and Freshwater Fisheries Act (1975)³⁶ that in order to fish for salmon, trout (including migratory trout), freshwater fish and eels in any* waters in the South West Region, anglers need an NRA National rod licence and permission from the owner of the fishery.

* = Except in waters where a General Licence is in force - please check with the owner of the fishery in advance.

There are many other legal requirements relating to fisheries matters, information is available from the Fisheries Department, NRA Cornwall Area Office.

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Byelaws

The Tamar fishery is in addition protected by many byelaws. A full list is available from the Fisheries Department, NRA Cornwall Area office.

The open fishing seasons in the Tamar Catchment i.e. the period when it is permitted to fish are:

Salmon	1st March - 14th October
Migratory trout	3rd March - 30th September
Brown trout	15th March - 30th September
Rainbow trout	15th March - 30th September
Coarse fish + grayling	16 June - 14 March

Within still waters there is no rainbow trout close season.

A new byelaw on the River Tamar has recently been approved by MAFF, to provide that *"On the River Tamar and on those tributaries which join it upstream of the Spaniards Inn at Cargreen at National Grid Reference SX 44385 6265, no person shall, after the 31st August in any year, use as bait any shrimp, prawn, worm or maggot, whether real or imitation, when fishing with rod and line for salmon or migratory trout"*.

Local Reservoir Operations

Roadford

Construction of Roadford Reservoir commenced in 1986 with impoundment in October 1989 (see Section 4.11). Part of the Roadford storage (2273ML) is reserved as a fisheries bank and can be used by the NRA to make releases for fisheries purposes to protect fish stocks and encourage migration into freshwater from the estuary in times when natural flows are low.

In addition, the Water Company have set out an Enhanced Flow Programme to 1997. This provides for special releases of water during the year to encourage fish migration in the River Wolf, notably for migratory trout and effectively makes use of the surplus water in the reservoir which is available during the early years of the scheme.

The prescribed flow at Gunnislake is due to be reviewed in 2002, based on information from a programme of environmental monitoring and investigation work which commenced in 1984. Key fisheries elements of this investigation programme are the salmon radio-tracking study, fish trapping at Gunnislake, the Gunnislake fish counter, annual electric fishing surveys and redd count observations. Interim results were presented in the Roadford Operational and Environmental Study (ROES) report⁶, in January 1990. A full review of this data is planned for 1995.

For details of Roadford Reservoir operations see Section 4.11.

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Lower Tamar Lake

The river below Lower Tamar Lake was identified as a potential low flow problem area (see Section 5.2.3) and an investigation is ongoing into the impact on the fishery. This investigation began in 1992 and comprises twice yearly electric fishing surveys, redd counting, and the tracking of radio-tagged fish that may migrate as far as the upper Tamar and analysing their movement in relation to flows. There is still one more year of the project to complete before any conclusions and recommendations can be made.

NRA Stocking and Hatcheries

The NRA South Western Region's major salmonid hatchery, Endsleigh, is sited adjacent to a small tributary of the lower River Tamar. Its total capacity is for 770,000 fish. Salmon and sea trout broodstock are collected and held at the hatchery until they are ripe for spawning. They are then stripped of eggs which are artificially hatched and the fish are reared for stocking (as fry, parr and smolts -see glossary) into the Lyd subcatchment, River Deer, River Carey, Upper Tamar and River Inny. Fish are also reared for stocking in the Devon Area into the River Exe, River Axe, River Torridge and the River Otter.

30,000 one year old salmon and sea trout per year are stocked into the Rivers Wolf and Lyd as part of the Roadford Mitigation Scheme.

As part of the Upper Tamar and Tributaries Environmental Improvement Project (see 5.3) juvenile (0+) salmon and sea trout are stocked into the Tamar and tributaries upstream of Launceston. Numbers vary according to availability (4,000-20,000 per year). A National NRA stocking policy is imminent and will supersede current NRA arrangements.

4.3 Agriculture

Over 80% of the land in England and Wales is farm land. The way this land is used affects the quality of our water environment. We are concerned about the pollution of surface and groundwaters from animal wastes, fertilizers and pesticides. Soil erosion, land drainage and stock damage to riverbanks can also be a problem. A sustainable farming system that conserves the soil and minimizes and recycles wastes will reduce the risk of damage to the water environment.

Our Objectives

- * to encourage agricultural practices that improve the water environment
- * to protect the water environment from farming activities.

The Role of the NRA

There is only a limited range of things we can do to influence the way farmers use land. Other agencies such as MAFF can encourage sensitive farming practices using financial incentives. However we can control and prevent pollution in the same way as we do with any other industry.

We have duties and powers to:

- * prevent and control pollution through the enforcement of the Control of Pollution (Silage, Slurry & Agricultural Fuel Oil) Regulations 1991
- * deal with pollution incidents
- * issue consents to discharge from farms. However we encourage farmers to dispose of farm wastes to land rather than discharging treated waste directly to rivers
- * regulate the abstraction of water for use on farms
- * control certain structures in, over or under watercourses through land drainage consents

Our work involves a range of activities:

- * we assess the impact of farming on water quality, prioritizing our work where there are gaps in our knowledge
- * we promote the designation of water protection zones and stopping certain activities within them, (Nitrate Sensitive Areas are an example of this)
- * we target our pollution prevention work where it is needed most
- * we visit farms so that pollution can be prevented
- * we are developing best practices to prevent pollution from the storage and disposal of farm wastes, and from the management of farmland. These best practices will include measures such as buffer zones or other schemes to prevent pollution and improve rivers and wetlands for wildlife
- * we inform farmers and the public about the pollution problems caused by farming
- * we work with other agencies such as MAFF to make the most of our pollution prevention work
- * we encourage farmers to use the Codes of Good Agricultural Practice for the Protection of Water and Soil
- * we urge farms to use the free pollution prevention advice available from ADAS on behalf of MAFF

Map 7 - Agriculture



4.3.1 Local Perspective

Agricultural land covers approximately 85,000 hectares of the Tamar Catchment, some 91.6% of the total area. The majority of the agricultural land, some 87%, is grass. Long-term leys (over 5 years) covers 66% of the agricultural area. Rough grazing on the moorland fringes accounts for 5.3% of the total, short-term leys 14.2%, with 9% crops or fallow. (source: MAFF, Land Use Planning Unit)

Table 3: Agricultural land use

Agricultural Land Use	1983	1988	1993
Grassland < 5 years	17.3%	16.1%	14.2%
Grassland > 5 years	64.6%	65.2%	66.2%
Rough Grazing	6.4%	6.0%	5.3%
Crops and Fallow	8.6%	9.5%	9.1%
Farm Woodland	1.8%	2.0%	2.6%
Other Land	1.3%	1.3%	1.7%
Set-Aside	0.0%	0.0%	0.8%

Source: MAFF

Agricultural activity in the Upper Tamar Catchment (north of Launceston) is primarily dairying, beef and sheep rearing. The high rainfall and heavy, impermeable nature of the soils means that much of the grassland is easily trampled and not suitable for intensive grazing. Marshy areas occur on Tedburn soils that are poorly drained and difficult to improve. In these areas and on the higher land towards Bodmin Moor livestock rearing is the predominant activity. Dairying takes place on the better drained land together with the growing of fodder crops and cereals. There is extensive land drainage in the north of the catchment, (around 75% of the land is drained) which may have a variable impact on the rivers. The clay nature of the soils mean that in the autumn and winter the land is covered with many small watercourses, including ditches. Applications of slurry and fertilizers to such land can easily find their way into watercourses.

The lower Tamar Catchment has suitable land for intensive grass utilization, the free draining and stable soil structure enabling it to withstand a considerable amount of treading by livestock. Here there is more dairying and fodder crops with occasional cereals. The better drained parts of the alluvial soils in the valley bottoms of the River Tamar and its main tributaries, although being vulnerable to occasional flooding, can be used intensively.

The dairy herd in the Tamar Catchment has fallen over ten years by 12% to just under 33,000 cows but there has been a dramatic increase of 75% of beef cattle, from 8,000 to 14,000. A similar large increase has been seen in sheep.

The soils are too wet to support much cereal growing. Acreage under maize is increasing at the top of the catchment. The heavy manuring and late harvesting of this crop has the potential to cause surface water runoff of farm waste during periods of winter rainfall unless carefully

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managed. The overall cereal acreage has fallen although an increase in winter-sown cereals reflects the higher margins to be gained from such crops. Farm woodland has doubled in the past ten years mainly due to woodland incentive schemes and grants.

Long term trends indicate that the movement to two types of holding, part time farms or large specialist units, is likely to continue. The trend towards large dairy holdings and subsequent concentrations of livestock increase the risk of any pollution incident causing fish kills due to larger volumes reaching the water course. However, larger farms are likely to be better financed to handle farm waste. The smaller holdings are becoming part-time and interest in diversification schemes will increase to maintain employment and incomes. Reforms in CAP, GATT and milk marketing are likely to exacerbate these trends. Farm diversification can have various impacts on the water environment and concerns for the NRA; i.e. pond creation and sewage treatment.

Table 4: Farm types

Farm Types	1983	1988	1993
Dairy	29.5%	26.4%	22.2%
Cattle & Sheep	17.3%	18.1%	19.5%
Pigs & Poultry	1.1%	0.8%	0.8%
Cropping	0.1%	0.3%	0.8%
Horticulture	0.8%	2.3%	1.6%
Mixed	1.1%	1.2%	1.3%
Part-time	50.0%	51.0%	53.7%

Source: MAFF

There is a continuing decline in the numbers and severity of pollution incidents relating to farming. This has probably resulted from the extensive, proactive pollution prevention work carried out by the NRA and the subsequent positive response from the farming community. However, farming continues to have an impact on water quality within the catchment (See Section 5.1.1).

Waste-spreading to land in the Tamar Catchment may be an issue in the future. Land is already used for the disposal of agricultural wastes (exempt from licensing under Waste Management Regulations 1994⁷) and sewage sludges (which fall under the Sludge (Use in Agriculture) Regulations 1989⁸). In 1998 the disposal of sewage sludges at sea will be prohibited by an EC Directive. This could increase the loading to land, which may result in an increase in pollutions associated with land runoff. The NRA will recommend the use of the Code of Good Agricultural Practice for the management of spreading.

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Table 5: Pollution incidents arising from agricultural activities 1992 to 1994

Pollution Incidents	Major	Significant	Minor
Agricultural			
1992	2	9	77
1993	3	5	55
1994	0	6	48

Note: Definition of Severity Codes is given in Appendix F.

Map 8 - Forestry



4.4 Forestry

Well managed woodlands in the right places does not harm the water environment and will often bring benefits. However, in certain circumstances forestry development and management can cause problems. Areas of concerns to the NRA nationally include acidification, soil erosion, pollution, water yield, increased flooding risks and damage to wildlife habitats.

Regulation of forestry is the responsibility of the Forest Authority. To minimize these adverse effects the Forestry Authority has published a series of Guidelines in respect of Water, Nature Conservation, Landscape Design, Archaeology and Recreation against which all forest operations are assessed. These Guidelines encourage environmentally sympathetic forest planting, management and harvesting through grant aid using the Woodland Grant Scheme and the issuing of felling licences.

Our Objectives

- * to encourage forestry practices that improve the water environment
- * to protect the water environment from the negative effects of forestry activities.

The Role of the NRA

We have duties and powers to:

- * regulate some forestry works using land drainage legislation
- * Deal with pollution incidents.

Further initiatives the NRA is associated with include:

Improving consultation

- The NRA is currently consulted on a non-statutory basis by the Forest Authority in respect of applications under the Woodland Grant Scheme in relation to acid sensitive areas documented in the Forest and Water Guidelines. The Forestry Authority may require a formal Environmental Assessment for significant new planting schemes. The NRA is seeking improved links with the Forestry Authority to achieve a consistent and effective approach to the general environmental assessment of forestry schemes and operations. This should include felling and restocking which may have effects on the water environment comparable with new planting
- The NRA should be consulted if there is significant planting within the 'main river' floodplain. Formal consent will be required under Land Drainage Byelaws
- The NRA will continue its liaison with relevant local authorities on planting applications and in the production of Indicative Forest Strategies to ensure the water environment is taken into consideration
- The existing ad-hoc liaison arrangements which exist between NRA and forest managers, such as Forest Enterprise and Forestry Authority officers, will also be further developed.

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Best Practice

- The NRA is developing a more proactive approach to the Guidelines produced by the Forestry Authority to help NRA staff in their discussion with foresters. The NRA is also further developing "best practice" techniques through its R&D programme.

4.4.1 Local Perspective

Forestry and woodland cover approximately 6.4% of the Cornish side of the catchment area of which 5% is deciduous or mixed woodland. Data for the Devon side of the catchment is not available at present. A Forestry Authority census of British woodland is in progress and the South West counties will be covered over the next few years. Much was originally ancient natural and semi-natural woodland, once coppiced to supply charcoal. Over recent years much of this ancient woodland has been replanted.

Map 8 shows only the larger afforested areas. Smaller areas occur, particularly on steeper slopes alongside rivers.

A considerable amount of the woodland in the Tamar Catchment is situated on the heavy clay soils of the Culm Measures in an area of high rainfall and high winds. The combination of these relatively hostile factors has lead to monocultures of predominantly Sitka spruce with relatively little age diversity. The more fertile and sheltered valley sites, such as Lydford Gorge, contain a more significant element of broadleaf trees, particularly along streams and rivers.

The Lower Tamar valley around Gunnislake has a microclimate ideally suited to growing trees. Blanchdown Woods on the left bank of the lower Tamar is one of the largest coniferous growing areas in the catchment.

90% of new plantings are deciduous, with most blocks between 2 and 5 ha. Except on larger private units the production of timber is not the prime aim, the trend being towards amenity, conservation, landscaping and shelter belt plantings. This management can be expected to be more sympathetic in terms of impact on the water environment and landscape generally. There is forestry within the catchment owned and managed by Forest Enterprise (the operational arm of the Forestry Commission). This is managed with commitment to improve landscape and conservation value and public access to comply with statutory duty unless any such activity is prohibited by conditions of a lease agreement. The Commission's plans for medium and long term planting aim to introduce more diversity in species and age classes of trees and to introduce more open space into their woodlands particularly along streams.

The only identified Critical Load area (where sulphur levels, causing acidification, are considered to be impacting on the ecosystem - see glossary) within the catchment is the extreme east of the catchment on Dartmoor. There is only one large coniferous wood in this area, Thorndon Cross at the head of the River Thrushel. The acidic nature of the upper tributaries' headwaters is considered to be attributable to local geology.

CATCHMENT USES

In the Tamar Catchment, as in the rest of Cornwall and West Devon, the greatest potential for problems to the watercourse arises from pollution caused by careless harvesting. The Forestry Authority, which licenses felling, is aware of the general problem and advises applicants with reference to 'Forest and Water Guidelines'⁹. Within the catchment the NRA has specific concerns about the disturbance of contaminated land connected with the old mineral workings at Gunnislake (See 4.10).

Forestry is not considered to impact on total water resources within the catchment.

Forestry is not likely to be significantly developed unless financial incentives change therefore the leaning towards small non-commercial deciduous units will continue. It is unlikely that coniferous planting will be replaced with deciduous species when blocks are felled. At such a time however the Forestry Authority will be promoting deciduous planting as belts alongside watercourses, acting as buffer zones and conservation corridors, in line with the 'Forest and Water Guidelines'⁹.

Map 9 - Recreation



4.5 Recreation and Amenity

Millions of people spend their spare time enjoying our rivers and coasts. Where we can we try to improve facilities for these people but we must always safeguard the environment from the damage they might cause.

Our Objective

We maintain rivers so that they can sustain angling at an appropriate level and seek to develop the amenity and recreational potential of inland and coastal waters and associated land.

The Role of the NRA

We have duties and powers to:

- * maintain, improve and develop fisheries allowing for a sustainable harvest of fish by anglers where appropriate
- * raise money for fisheries management by issuing rod licences for freshwater angling
- * enforce regulations and byelaws to prevent damage to fish stocks
- * protect and maintain access to beautiful areas or special sites of interest
- * make sure that land and water under our control is made available for recreation and at all times provide for the needs of the chronically sick or disabled
- * charge for facilities that we provide for recreation
- * make byelaws to regulate recreation.

We are involved in a range of activities:

- * we encourage angling and publish leaflets for anglers
- * we work with other agencies such as planning authorities and sports associations to develop recreation facilities
- * we work with other organisations to develop plans and strategies for promoting recreation in the water environment.

4.5.1 Local Perspective

Angling

The Tamar and tributaries is a nationally recognized salmonid fishery with angling taking place throughout much of the catchment. The salmonid rod fishery also extends for some distance downstream of Gunnislake Weir. The fishing rights are owned by fishing clubs and private individuals. There is no recognized riverine coarse fishery on the River Tamar or its tributaries. The reservoirs owned by South West Water Services are open for bankside fishing.

Roadford Reservoir and Tamar Lakes

South West Water Leisure Services manage recreation and conservation at Roadford and the Tamar lakes, which are used for the following:

Roadford Reservoir

Since its completion in 1989, Roadford has developed as a recreation and wildlife site (see also 4.1). It provides 730 acres of open water, some of which are used for canoeing and dinghy sailing. Eight and a half of its 13 miles of shoreline are used for fly-fishing and the lake is

CATCHMENT USES

becoming one of Britain's major brown trout fisheries. There are a network of footpaths and bridleways around the shore and the lake is used increasingly by birdwatchers, for whom there are two bird hides.

Tamar Lakes

Upper and Lower Tamar Lakes both have considerable other recreational use and wildlife value. Upper Tamar Lake is a stocked rainbow trout fishery. Other fish species present include brown trout and common bream. A large number of common bream in the lake were killed by disease in 1991. Lower Tamar Lake is a stocked coarse fishery, one of an increasing number within the catchment. Fish species present include carp, tench, bream, rudd, roach, brown trout, eel and dace. The future of Lower Tamar Lake is currently in some doubt, see 5.2. Both Lakes have in the past been affected by blue-green algae blooms which may have impacts on human and animal health, see 5.1.

Sailing takes place on the Upper Lake and birdwatching takes place around both lakes.

Canoeing

Canoeing on the Tamar River is permitted at weekends (excluding Remembrance Sunday) between 16 October and 28 February with written permission from the riparian owners on the stretch between Greystone Bridge and the Tidal limit. Up to 30 paddles are permitted at any one time, with groups being led by a senior instructor.

Public Access

There is limited public access along most of the rivers within the catchment and therefore low recreational usage except for a few intensively visited sites. Forest trails run through the Lyd Valley and Holsworthy Woods. The Tamar Otter Park at North Petherwin has riverside walks alongside Bolesbridge Water and a bridleway and river crossing at Tamartown is being reinstated.

The headwaters of the Rivers Lew and Lyd lie within the boundaries of Dartmoor National Park. Lydford Gorge is owned by the National Trust who estimate annual visitor numbers at 3,500.

Devon County Council are investigating possibilities of several long distance recreation footpaths in the catchment such as a Tamar Trail, along the River Tamar and the Bude Canal taking in areas of interest such as Kit Hill Country Park and Clitters Mine, Gunnislake. Other routes include an 'A30 Corridor' route through the Lyd and Lew Valleys from Bridestowe to Launceston and using the disused railway lines from Holsworthy to Halwill Junction on the north eastern edge of the catchment.

These plans would enhance public access to the riverside. However, the catchment is extremely valuable for many forms of flora and fauna. The NRA would support careful management of increased access to ensure that such activity does not disturb the habitats of these sensitive species.

4.6 Aquaculture

Here we consider the use of riverside beds or ponds to rear fish. Water used by fish farms is all returned to the river at some point downstream of the abstraction. Impacts arise due to the reduction in river flow in the by-passed reach and from the effluents in the returned water.

Our Objective

To protect rivers from the negative effects of fish farms.

The Role of the NRA

We have duties and powers to:

- * issue abstraction licences to protect the water environment and legal uses. We can put conditions on new licences to achieve this
- * issue discharge consents to protect the river from pollution caused by fish food or chemicals used to control pests or diseases
- * control the movement of some fish to prevent the spread of diseases. MAFF are responsible for registered fish farms
- * ensure that farmed fish cannot escape and compete with native species.

Our work involves a range of activities:

- * we tackle the problems caused by historic licences
- * we prevent fish escaping to the wild by making sure that farms fit screens
- * we consult fully with the local planning authority on applications for new fish farms
- * we are looking at ways of regulating fish farming in cages in estuaries.

4.6.1 Local Perspective

There are 3 fish farms in the Freshwater Tamar Catchment including the NRA hatchery at Endsleigh.

Over the past few years the NRA has been reviewing the authorizations of commercial fish farms in the area. A Fish Farm Control Group was set up to make sure that all fish farms had all relevant permissions for abstractions, discharges and weirs. Changes in licensing following the Water Act 1989¹⁰ had given rise to anomalies that the Group has endeavoured to put right (see Section 4.11, Licences of Entitlement).

Table 6: Fish farm abstractions/discharges

Fish farm	NGR	Abstraction	Discharge
Endsleigh Hatchery (NRA)	SX 393 783	Spring fed 785.5 m ³ /day	1136m ³ /day
South Reed Fisheries	SX 494 912	Spring fed 273.0 m ³ /day	Under review
Woodley Fish farm	SX 418 754	1,364 m ³ /day	Revoked

CATCHMENT USES

Environmental impact from the fish farms has been limited:

- * Endsleigh failed discharge consent assessment in 1994 (see 4.12)
- * Woodley fish farm has caused the stream to dry up between abstraction and discharge points in periods of dry weather and despite licence conditions which should prevent this.
- * South Reed Fisheries is primarily a fish farm rearing coarse fish and no problems are known.

There are numerous fisheries within the catchment however these are not issued with a discharge consent as they are not normally likely to cause reduced water quality. One fishery holds an abstraction licence.

4.7 The Built and Developing Environment

Developments associated with the built environment have significant implications for the water environment. New developments require the extraction and processing of building materials. They alter the natural landscape, causing increased surface water runoff which could lead to flooding and introduce activities which bring a higher risk of pollution. New housing and industry increases the demand on services, including water supply, and result in increased amounts of waste which require treatment and discharge from sewage works or disposal to land.

Globally, it is recognized that human activity and demands are exceeding the Earth's carrying capacity. International concerns and desire for sustainable development culminated in the United Nations Conference on the Environment and Development held in Rio de Janeiro in 1992 where many nations signed up to a declaration of rights and obligations with respect to environment and development, called the "Earth Charter", and an agenda for action, "Agenda 21". The UK Government has responded positively to concerns through its White Paper "This Common Inheritance"¹¹ and the Government Planning Policy Guidance. In considering sustainable development policies and strategies, the NRA is keen to promote balanced development, i.e. an appropriate balance between the built and natural environment. This will be achieved through the protection and enhancement of the natural environment and efficient and wise water management.

The County and District Planning Authorities are responsible for controlling development within the catchment. The determination of planning applications is on the basis that developments should be allowed unless the proposal would cause demonstrable harm. In determination, a number of policy matters are taken into consideration with decision making being guided by development plans (structure and local), government advice in planning policy guidance notes (PPGs) and Department of the Environment (DoE) circulars. Local authority policy documents add further guidance.

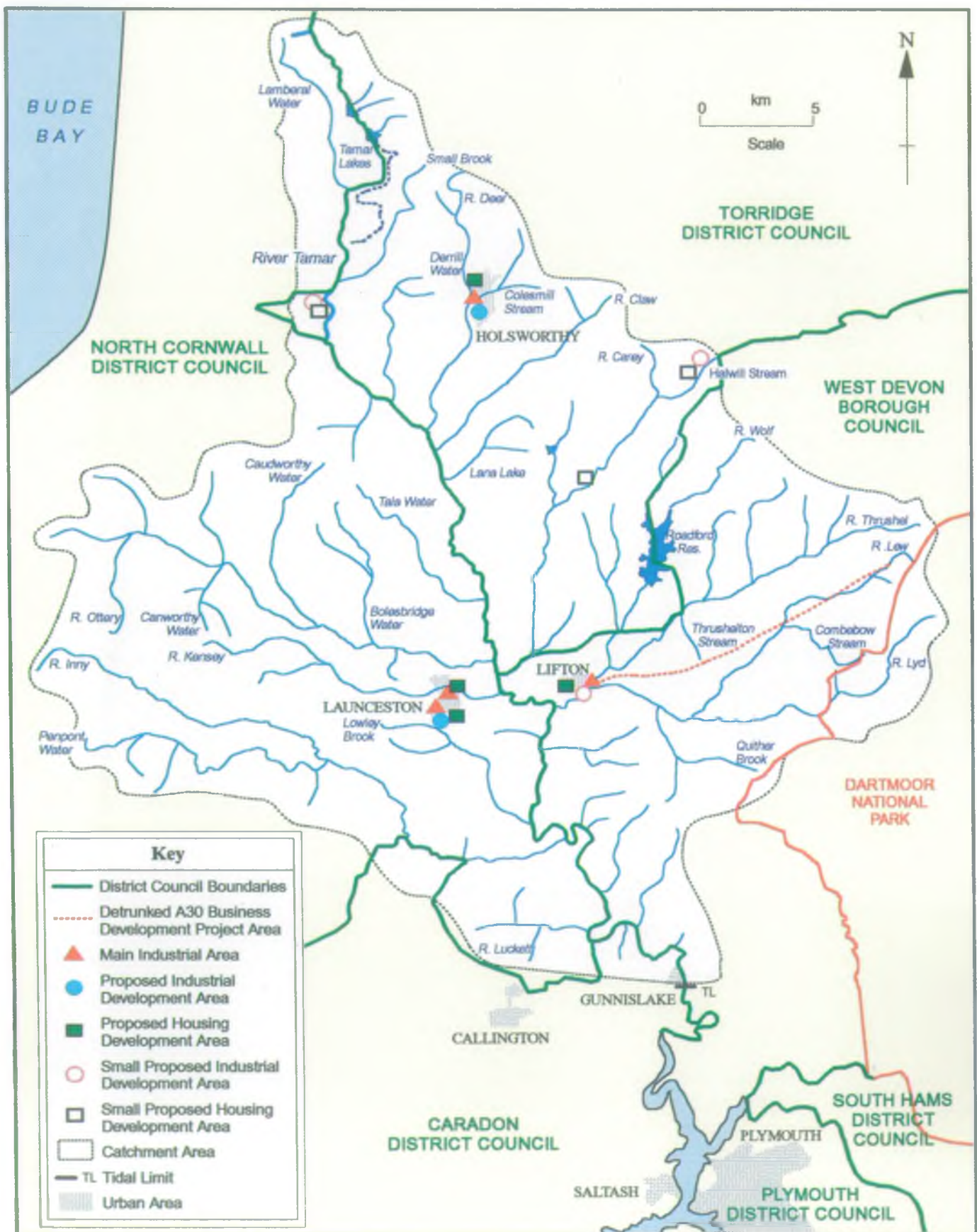
The Role and Objectives of the NRA

The NRA has some limited control over development through its own powers under the Land Drainage Act 1991¹² and the Water Resources Act 1991¹³. These relate to the consenting of development in, over or under water courses, and the control of discharges into and abstractions from the water environment (see Section 4.8 and 4.11).

The NRA is unable to independently control developments. However, the NRA is a statutory consultee to local planning authorities for development plans and specified types of development proposals. Various DoE planning circulars also identify the NRA as advisors to the Local Planning Authorities (LPAs), in particular 30/92 "Development and Flood Risk".¹⁴ In order to fulfill the aspirations within the NRA's Mission Statement and to carry out its commitment to sustain all uses of the water environment, the Authority will:

- influence development planning by assisting strategic and local planning authorities in formulating policies, allocating development, identifying constraints and highlighting opportunities for enhancement of the river environment and guidance notes, such as "Guidance Note for Planning Authorities, NRA, January 1994"¹⁵.

Map 10 - Built Environment



CATCHMENT USES

- guide development control by formal and informal consultation on planning applications, and the production of planning consultation guides.
- influence national policy and public debate through the publication of reports, representations to Government departments, presentation of evidence to Select Parliamentary Committees and funding of appropriate research and development projects.
- publish, in consultation with the DoE, policies for the protection of the water environment such as the "Policy and Practise for the Protection of Groundwater"¹⁶
- request the Secretary of State to make regulations under the provision of the Water Resources Act 1991,¹³ for example the Control of Pollution (Silage, Slurry and Agricultural Fuel Oil) Regulations 1991³⁷.

4.7.1 Local Perspective

Developing Environment

Development Plans. The hierarchy for development plans is:

- South West Regional Plan
- County Structure Plan
- Waste and Mineral Local Plans
- District Plans
- Development Briefs

The South West Regional Plan provides the framework in which each subsequent plan's policies are developed and handed down. In its advice to the Secretary of State for the Environment for the **South West Regional Plan** (unpublished), the South West Regional Planning Conference embraced the principles of sustainable development and recommended:

- development decisions in the region must take account of the need for the protection, conservation and efficient management of water resources, and the maintenance and improvement of the quality and volume of supplies.
- the region's coastline must be conserved and managed to secure an appropriate balance of uses on land and water compatible with the reduction and minimisation of pollution, the protection of undeveloped areas and the enhancement of its beauty and nature conservation value.
- the environmental consequences of development proposals, including the implications for energy, water resources, waste disposal and pollution must be a prime consideration in preparing development plans, and in the development control process in the region.

The **Regional Strategy**¹⁸ which is currently before the Secretary of State for the Environment, will be finalized in the summer of 1994 and predicts a housing increase of 47,000 new dwellings for Devon and 21,700 for Cornwall between the years 1991 and 2001, and 52,000 for Devon and 23,300 for Cornwall between 2001 and 2011.

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Part of this total has already been committed in the **Cornwall Structure Plan**³ which runs from 1986 to 2001 and the **Third Alteration of the Devon Structure Plan**¹⁹ which was approved by the Secretary of State on the 10th March 1994. The Third Alteration runs from 1989 to 2001 and allocates 3,300 new dwellings to West Devon, 6,500 dwellings to Torridge and 1,000 dwellings to Dartmoor National Park. Between 35% and 42% of this development is allocated to areas of economic potential. The deciding criteria for areas of economic potential is settlements with a population in excess of 50,000. Employment land from 1989 to 2001 has also been allocated, 32 ha to West Devon and 73 ha to Torridge.

West Devon

A new section of the main arterial road into Cornwall, the A30, between Sourton and Lifton Down, was opened in 1994. This has led to the de-trunking of the old A30 that passed through Lewdown, Lifton and near Bridestowe. The effects on these villages in terms of residential and industrial development are not yet fully known. West Devon Borough Council and the Rural Development Commission have set up the Business Development Project to encourage new enterprise and initiatives in the area affected.

North Cornwall

Launceston, located alongside the A30, is set to become the commercial centre for the Tamar Valley. Significant amounts of employment land are planned at Launceston including a new business park and extensions to the existing industrial estates. This expansion may affect travel-to-work patterns throughout the Tamar Catchment. The main area marked for development is south and south-west of the town between Tavistock Road and Link Road. The sewage treatment works at Launceston underwent major upgrading in 1993 and has capacity for this growth but the NRA has concerns that the surface drainage from the development will overwhelm the small watercourse (Lowley Brook) it will discharge into. The NRA have highlighted that proposed housing development in the Kensey Valley could exacerbate flooding problems. North Cornwall District Council have said in their 1994 Draft Local Plan that they will look towards recreational areas being developed in the most vulnerable riverside locations.

Torridge

Holsworthy has been identified as an Area Centre by Devon County Council, which will continue its role of serving the surrounding community. Development that provides employment, services and related housing will be encouraged in the town.

Local Land Use and Planning Initiatives

The Tamar Catchment is a Rural Development Area and has been designated under European Structural Fund Objective 5b which provides support for rural areas. The Dartmoor Area Tourism Initiative has been set up to raise the profile of the surrounding area to reduce the pressure on the National Park. This will involve a large part of the of Tamar Catchment.

The Torridge Landscape Assessment is funded by a number of agencies including Torridge District Council. This assessment of the area includes issues that are explored further in Section 5.3.

The NRA is currently discussing issues with Cornwall County Council for the New Structure Plan³, Waste Disposal Plan and Minerals Local Plan²⁰. We are also involved in the emerging Districts' Local Plans.²¹ The NRA will seek to influence the allocation of land to ensure that adequate infrastructure exists prior to development and, furthermore, that development does not damage conservation interests or be at risk from, or result in, flooding.

CATCHMENT USES

All local plans have incorporated a number of policies for positively protecting the water environment as a result of early discussions with the NRA.

The NRA recommend formal development restraints in areas where there is inadequate sewerage and sewage treatment systems which result in unacceptable pollution. A schedule of such settlements is presented to the relevant council annually. The recommendations are then formally debated and accepted as **Policy**. A list of settlements in the Tamar Catchment is given on Table 7, page 46. It should be noted that these are small in size and impact on the water environment is localised.

Road Schemes

The NRA is a statutory consultee to the Department of Transport for new trunk roads and advises County and District Councils on their own road schemes. The NRA are involved throughout the process, from route choice and design to construction.

Particular areas of concern are:

- pollution risks from spillage of oil and chemicals
- flood risk from surface runoff
- damage to the amenity and wildlife value of rivers and wetland.
- possible pollution and flood risk during construction.

Road improvements to the A39 at Kilkhampston brush the north west edge of the catchment. The final route option is not yet known but the proposed routes east of the village could impact on tributaries of Lamberal Water. The NRA has commented to the Highways Agency to ensure that safeguards are made during construction and for surface runoff.

Industry

The Tamar Catchment is agricultural in nature, with no heavy industry. The southern part of the catchment is in the Plymouth travel-to-work area. In addition to industrial estates in Launceston, Holsworthy and Lifton a number of small industrial sites are scattered throughout the catchment. Assessment of risk to the water environment by these sites is undertaken by the NRA during its winter Task Force operations.

There are two creameries in the catchment, one on the River Lyd at Lifton and the other at the headwaters of the River Inny. The impacts of these on the water environment are described in Sections 4.11 and 4.12, Abstraction and Effluent Disposal.

Tourism

Tourism may not have the extreme impact on the freshwater Tamar Catchment as it does on the coastal regions, but it is a major employer and land user. Focal points occur at accommodation centres (such as caravan parks) and activity centres/tourist attractions. Seasonal population increases have implications for infrastructure and service provision.

Many small scale holiday parks have been built over the last decade throughout the upper catchment. NRA Farm Campaigns on the Tamar have raised awareness of potential pollution problems in the area and these parks usually have adequate sewerage facilities. Holiday lets on farms and diversification schemes such as visitor centres will increase over the next decade. Roadford reservoir is easily accessible from the new A30 and development of recreational facilities and accommodation on the western banks of the lake is being explored.

CATCHMENT USES

Table 7: Development restraints due to problems in sewerage infrastructure

Development Restraints	
Settlement	Reason
Bratton Clovelly	Environmental effect caused by effluent discharge. Further increase in flow will cause deterioration in water quality.
Lawhitton	Environmental effect caused by effluent discharge. Further increase in flow will cause deterioration in water quality.
Lewannick Polyphant	Environmental effect caused by effluent discharge. Further increase in flow will cause deterioration in water quality.
Lydford	Storm sewage overflow causes pollution.
Pyworthy Derrill Hoppatown	Environmental effect caused by effluent discharge. Further increase in flow will cause deterioration in water quality.
St Giles on the Heath	Environmental effect caused by effluent discharge. Further increase in flow will cause deterioration in water quality.
Sydenham Damerall	Environmental effect caused by effluent discharge. Further increase in flow will cause deterioration in water quality.
Tresmeer	Environmental effect caused by effluent discharge. Further increase in flow will cause deterioration in water quality.
Wainhouse Corner	Environmental effect caused by effluent discharge. Further increase in flow will cause deterioration in water quality.
Whitstone	Environmental effect caused by effluent discharge. Further increase in flow will cause deterioration in water quality.

4.8 Flood Defence

River flows vary widely and are affected by the weather, geology and land use. We manage flood risk from rivers and the sea using Flood Defence and Land Drainage powers.

Flood risk and land drainage have always affected the way we use land. By improving our control of water we have been able to make better use of river and coastal floodplain for farming or building towns. This control can take many forms: from simple channel alterations to major floodbanks and artificial washlands. Works constructed for other purposes, such as weirs, mills and bridges, have also altered the natural river system.

Better protection from floods and better land drainage has improved our quality of life. However, unless properly managed, these benefits may result in other problems such as increased downstream flows and a legacy of expensive works for future generations to maintain. Changes in land use, made possible through drainage and flood defence, may also cause significant environmental damage, particularly to wetlands.

Today we manage flood defences and land drainage to balance the needs of all river users with the needs of the environment.

Our Objectives

To provide effective defence for people and property against flooding from rivers and the sea; and to provide adequate arrangements for flood forecasting and warning

The Role of the NRA

Legislation tells us what we can and can't do. Our statutory flood defence committees make decisions on flood defence. All rivers are classified as either "main rivers" or "ordinary watercourses" (sometimes referred to as "non-main rivers"). We control work (through land drainage consents) and supervise flood defence matters on all watercourses, but have special powers to carry out work on main rivers and sea defences. Local authorities have the same special powers for flood defence on ordinary watercourses.

We have duties and powers to:

- * control certain works and advise planning authorities on flood defence
- * maintain and improve the flood defence system which is under our control
- * provide flood forecasts and warnings so that risk to life and damage to property is reduced during river and sea floods.

We are involved in a range of activities:

- * we work closely with other agencies including MAFF, local authorities, conservation and recreation bodies
- * we survey assets and flood risk areas to improve our management of flood defence
- * we are working on a Flood Defence Management Framework and related systems to ensure that flood defence assets are managed properly
- * we set and monitor specific targets to improve our performance
- * we support Research and Development and are developing best practices for our work.

Map 11 - Flood Defence



4.8.1 Local Perspective

The Tamar Catchment is a rural area of scattered communities and market towns. The river systems are well developed with extensive floodplains, used primarily for agriculture (see Section 4.3). The upper reaches are in clay/loamy soils with high moisture retention and fairly fast runoff once saturated, however extensive land drainage has changed flow patterns.

The River Tamar and its tributaries run a natural course for most of their length and have not been unnaturally directed or constrained other than where there are reservoirs. Operation of the reservoirs, particularly Roadford Lake, affects natural flow patterns.

167.05 km is classified as main river, the lengths are shown on Map 11.

Regulation

As a rural catchment the only proposed development of any size will take place around Launceston, Holsworthy and Lifton/Tinham. The NRA response to draft local plan proposals (where available) and specific planning applications has been to guide development away from flood risk areas, in line with NRA policy and the government circular 30/92 'Development and Flood Risk'.¹⁴ As part of this process detailed plans showing the indicative floodplains are being produced in accordance with Section 105 of the Water Resources Act.¹³ The NRA wishes to ensure that this work also meets with the needs of the planning authorities and a Memorandum of Understanding between the NRA and the Associations of County Councils, District Councils and Metropolitan Authorities has been produced.

The NRA is concerned that if development were to take place to sites close to the rivers in the Kensey Valley at Launceston and the Lyd Valley at Tinham then flood storage in the floodplain will be reduced, with consequent increase in flood levels (see also Section 4.7).

For sites to the south of Launceston and to the north-west of Holsworthy our concern is for adequate capacity to be available in the minor watercourses that will receive surface runoff (small tributaries of Lowley Brook and the River Deer).

Other development tends to be small in scale and isolated, and of no great concern in flood defence terms (except for some isolated barns given planning permission against our advice) unless the site is of risk from flooding itself. We receive a steady flow of enquiries and formal applications for building structures in, over or under rivers. All of these require the formal approval of the NRA. The most common are utility crossings (such as gas and water mains) and headwall structures (such as surface water sewer outfalls). Proposals for culverts, bridges, weirs, dams and other structures are also dealt with.

Flooding (see Map 11)

Flood alleviation schemes are present at Bridgerule, Forder Mill, Tinham, Yeolmbridge, Canworthy Water and Launceston. To date these have all performed as designed. Historic records show flooding has occurred in a number of other locations around the catchment, the bulk of which affect highways or a small number of properties. Most occur on ordinary watercourses on which the local authorities have powers to carry out work.

CATCHMENT USES

The rate at which river water rises in response to rainfall in the Tamar Catchment is typically within 4 - 6 hours. Upper Tamar floods pass through the river system in a similar time-scale. The Rivers Ottery and Kensey however receive heavier rainfall and can respond more quickly.

Maintenance

At the present time maintenance work falls into the following five categories:

- 1 Routine maintenance on flood schemes consisting of grass cutting, vegetation trimming, tree management, servicing flapvalves and clearing weed screens.
- 2 Infrequent dredging or shoal removal carried out every 2-10 years depending on need, and generally where flood schemes are located.
- 3 Infrequent repairs and minor enhancements of flood schemes.
- 4 Clearance of fallen trees and debris dams anywhere within catchment.
- 5 Infrequent clearance work, approximately every 10 years, along watercourses to avoid loss of flood capacity and reduce risk of trees being washed into rivers and causing debris dams, particularly at river crossings, during flood events.

At the present time the annual cost of maintenance is of the order of £20K to £60K depending on the range of work carried out.

Annual conservation liaison meetings are held to outline our maintenance programme to external conservation bodies. Each year within this programme some conservation enhancements and recreational improvements are carried out.

The main elements of work detailed in 1 and 2 are included within informal contracts known as Service Level Agreements. Anyone who has a specific interest regarding such work can make a formal request to the NRA to view the maps within these documents.

CATCHMENT USES

A system has been developed by the NRA to assess the standard of service needed for Flood Defence maintenance. The system uses the term 'House Equivalents' (HEs) to equate the value of all types of land for different land use factors. (see Table 8 below)

Table 8: Land use factors

Land Use Factor	Unit	HE units
House	Total number	1.0
Garden/allotments		0.04
Non Residential Property	Total area (m ²)	
- Distribution		0.038
- Retail		0.026
- Manufacturing		0.021
- Leisure		0.022
- Offices		0.024
- Agricultural		0.010
C roads	Total number	2.4
B roads		5.7
A roads (non-trunk)		14.3
A roads (trunk)		28.6
Motorway		57.3
Railway		57.3
Forestry & Scrub	per 100 ha	0.02
Extensive Pasture		1.07
Intensive Pasture		2.47
Extensive Arable		5.19
Intensive Arable		36.20
Formal Parks	Total number	0.52
Golf/Race Courses		0.54
Playing Fields		0.07
Special Parks		7.58

Map 12 - Flood Defence - Main River and Standards of Service

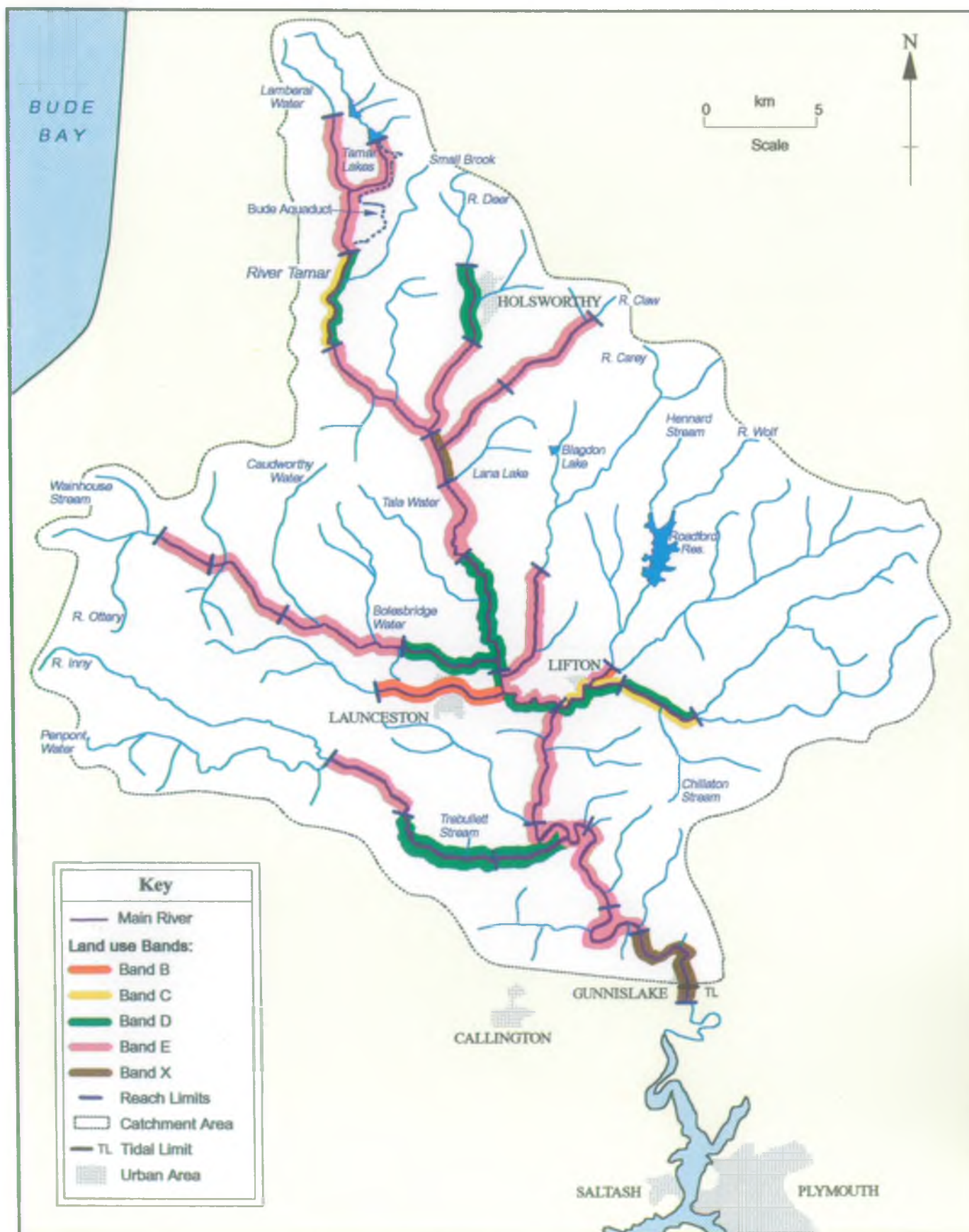


Table 9: Typical nature of land use by band

Land Use Band	Description of Typical Land Use
A	<p>A reach containing the urban elements of residential and non-residential property distributed over a significant proportion of its length, or densely populated areas over some of its length. Any agricultural influence is likely to be over-ridden by urban interests. Amenity uses such as parks and sports fields may be prominent in view of the floodplain's proximity to areas of population density.</p> <p>Band A = 50 or more house equivalents/km.</p>
B	<p>Reaches containing residential and/or non-residential property either distributed over the full length of the reach or concentrated in parts but characterised by lower densities than Band A. Agricultural use could be more intensive in the less populated area of band B reaches</p> <p>Band B = 25 to 49.99 house equivalents/km.</p>
C	<p>Isolated rural communities at risk from flooding, with both residential and commercial interests, will be found in band C reaches but in limited numbers. Consequently, farming interest will be more apparent than band A reaches.</p> <p>Band C = 5 to 24.99 house equivalents/km.</p>
D	<p>Isolated properties at risk from flooding, both residential and commercial, will be found in band D reaches but in limited numbers. Agricultural use will probably be the main customer interest with arable farming being a feature. Where band D reaches are found in undeveloped pockets of largely urban use, amenity interests may be prominent.</p> <p>Band D = 1.25 to 4.99 house equivalents/km.</p>
E	<p>There are likely to be very few properties and roads at risk from flooding in these reaches. Agricultural use will be the main customer interest with extensive grassland the most common land use in the floodplain. Amenity interests are likely to be limited to public footpaths along or across the river.</p> <p>Band E = 0.01 to 1.24 house equivalents/km.</p>
X	<p>A category X has been identified for those reaches where there is no area at risk from flooding. The absence of any area at risk may be due to both local topography and hydraulic conditions or may be due to the lack of information of the flooding that occurs in such reaches. It is important to identify band X reaches so that effort can be directed at identifying areas of risk and thus the interests that need to be protected, or where no risk area exists effort can be made to ensure that scarce resources are not used without firm justification in these areas.</p>

CATCHMENT USES

The methodology splits the river into reaches and defines typical land use on either side of the river (see Table 9). It then uses a combination of historic flood data and analysed flood data to determine the number of HEs affected per km per year. The higher the score the greater the need for maintenance or a capital scheme. Scores below 0.5 HEs/km/year indicate that maintenance could be reduced. Scores above 1.0 HEs/km/year indicate that maintenance might need increasing. Scores between 0.5 and 1 HE/km/year indicate that the level of maintenance is properly about right.

The system originally only looked at flood damage. However, it is recognized that damage due to waterlogging is important for agricultural land. Initial recommendations have been provided to include this important factor and further research work is being undertaken. Map 12 shows the land use banding for the Tamar catchment.

Improvement

Flooding to 2 properties has occurred at Bridgerule, where surface water runoff has been held back by the flood embankment. The NRA is in the process of building a small pumping station to alleviate this problem.

Work has been completed to improve the flow of water through the flood arches at Yeolmbridge on the River Ottery which is expected to reduce the peak height of future floods. Bank reinforcement has been carried out to protect the left bank. Altogether 7 properties have been affected in the past.

Bank raising and channel improvement are planned for the existing scheme at Forda Mill on the River Deer where 1 property has suffered.

Consideration is also being given to measures which might be taken to alleviate highway flooding at Derriton (Holsworthy) and Polson/St Leonards (Launceston).

Emergency Response

Flood forecasting and warning is carried out at the Regional Office in Exeter. Weather conditions and river levels are monitored 24 hours a day. Information and data is available from weather radar and forecast in addition to rainfall and river levels measured within the catchment. Flood warnings are colour coded yellow, amber or red to indicate their severity, red being the most severe. Warnings are based on threshold levels being reached at measuring stations upstream of flood areas. Location of stations used for flood warning are shown on the hydrometric network map (Map 2). Warnings are currently issued for the Rivers Upper Tamar, Lower Tamar, Ottery and Thrushel. Additional sites to extend the warning system are planned.

The emergency workforce respond to incidents as they occur throughout the catchment, there being no special locations where problems invariably arise.

In the last five years the emergency work force has attended flood incidents at Bridgerule, St Leonards, Lifton, Tinhay and Yeolmbridge.

4.9 Mining and Quarrying

The NRA recognizes the economic importance of quarrying, mining, gravel and mineral extraction to the region, however, exploration and extraction can significantly affect surface and groundwaters locally and across catchments.

Areas of concern to the NRA include:

- * Extraction which can result in the loss of aquifer material and groundwater resources. The effects on groundwater resources can cover a great distance and may be long term or permanent.
- * The removal of material from above the water table which reduces natural filtration and increases pollution risk to groundwaters.
- * Surface water runoff from spoil heaps and worked areas and discharges from mines and quarries which can contain toxic and suspended materials that are harmful to aquatic life.

Abandonment of mines and after use of quarries may also pose threats to the water environment.

Our Objectives

To minimize the damage that mineral extraction can do to water purity and to reserves of water held in the ground. Where possible we will steer mining and quarrying operations away from important aquifers.

The Role of the NRA

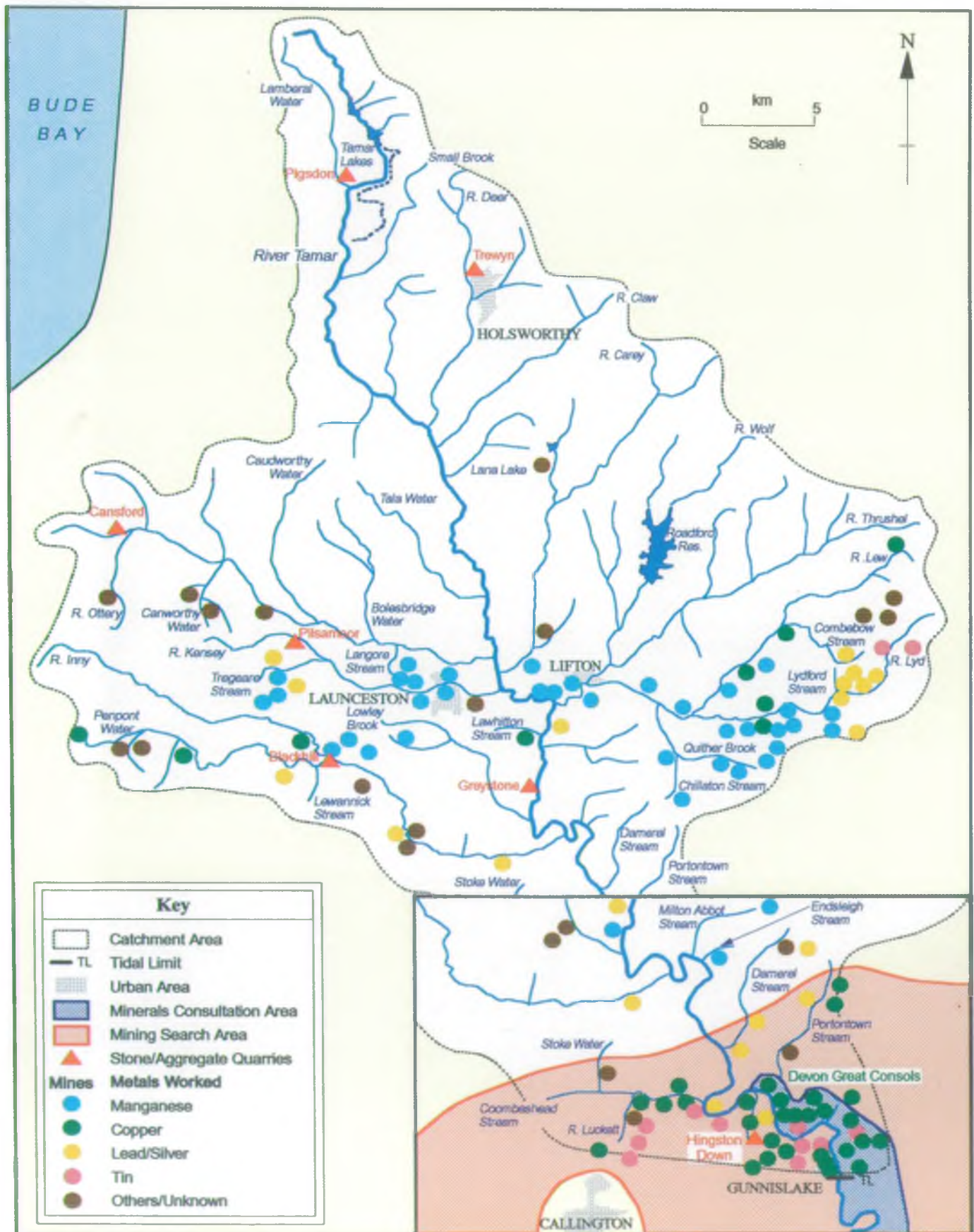
We have duties and powers to:

- * control the quality of water discharged from mineral workings
- * prosecute offenders if they cause pollution
- * issue Conservation Notices where mining/quarrying activities could have a negative impact on water resources.

We are involved in a range of activities:

- * We monitor the changes that existing mines, quarries and pits are causing to rivers, springs, wetlands and water supplies
- * Many existing quarries are not subject to modern planning conditions which are designed to protect water resources. We negotiate with mineral operators to improve situations where their operations are damaging surface water and groundwater
- * When new controls become available we work with planning authorities to obtain better standards and working practices
- * We advise planning authorities on the effects that proposals for new quarries and mines will have on water resources and the water environment. When a new mineral working is proposed that will cause harm to water resources and the water environment we will object to it
- * When needed we provide expert witnesses at public inquiries into mineral extraction proposals.

Map 13 - Mining and Quarrying



4.9.1 Local Perspective

There are small Minerals Consultation Areas north of Launceston and at Twobridges (stone) and the lower Tamar Valley from Horsebridge to Calstock (metalliferous ores). In these areas the County Councils need to control non-mineral development of a type that could lead to the sterilisation of mineral deposits or which by virtue of its siting or nature would not be compatible with mineral working or associated operations. Although there is no mineral working in the Tamar Valley at present and resumption of working could cause significant pollution the area has been identified as a Mineral Consultation Area because it is a nationally important metalliferous resource.

Historic Mining Activity

The NRA South Western Region has recently completed the 'Mines Database' project, set up to compile a systematic database on mines, adits and associated infrastructure. It is an attempt to collate information on the nature and drainage of specific workings. This should help the NRA be more pro-active and forward plan for potential impacts on the water environment as surveying of the internal workings of old mines is impracticable. Information has been gathered largely as a desktop exercise. Given the extent and historic nature of mining in the catchment, work to date cannot be considered totally comprehensive or accurate, but rather a first step. Further development of the project could include on-the-ground checks to verify and add to existing data.

Similar work is being carried out by Caradon District Council to provide guidance on areas of potential instability and there is liaison to share information.

Responsibility for the physical dangers posed by shafts and adits lies with the landowner, however, where there is public access and a perceived threat to public health the District Council may intervene.

There are 128 mines identified in the Tamar catchment. Historically, the most important mining area was a 3 km wide band at the bottom of the catchment in the Gunnislake/ Hingston Down area, embracing an extensive area of mineralisation extending into neighbouring catchments. Forty mines have been identified here, yielding copper, arsenic and pyrite from east-west trending sulphide bearing lodes and small deposits of tin, fluorite and wolfram. Devon Great Consols Main Lode was one of the richest sulphide lodes in South West England.

Manganese was mined within the chert beds in the Lyd valley, lower Carey valley and in the Milton Abbott area. Eight manganese mines, associated with the Firebeacon Chert Formation, are scattered throughout the Launceston area. A small number of manganese mines were worked near Warbstow Cross, with limited success. A cluster of mines near Two Bridges on the River Inny were worked for manganese, lead and silver from the Culm Measures.

Silver/lead mines have been identified in the west of the Kensey catchment within the Upper Carboniferous Crackington Formation and in a cluster near Lydford working north-south trending lodes. A cluster of 5 mines located around the headwaters of Penpont Water were worked for tin, tungsten and copper, in and on the edge of Bodmin Moor Granite.

CATCHMENT USES

Mining Impact on the Catchment

The southern part of the catchment is honeycombed with old workings and their associated shafts and adits. The enhanced underground storage and mine drainage systems has significantly altered the local hydrology, concentrating groundwater flows along drainage adits, producing major discharge points. Any collapse or blockage within the mine system may alter flow paths, discharge points and quality of water.

The shaft caps and internal mine structures are now believed to be deteriorating and collapses have occurred, such as that at Michael's Shaft in Gunnislake. Re-capping of shafts and installation of pressure relief valves to help prevent further shaft collapses in Gunnislake are currently being undertaken by Caradon District Council.

The exact locations of many of the old shafts, adits and trial workings are not known. The historic mining area from Kit Hill to Gunnislake has been identified by Caradon District Council as an area of Unstable (or potentially unstable) Land where any proposed development is subject to a Mining Search.

Elevated copper and zinc levels in the lower sections of the Tamar Catchment are considered to arise from the drainage of old mines, adits and spoil tips in the Gunnislake area. The problems are identified in the water quality 'state of the catchment' section (5.1).

Active Mineral Workings

There are six active and one dormant stone and aggregate quarries scattered throughout the catchment. Most are small scale workings of a few hectares servicing local markets.

There is a constant risk of intermittent pollution and problems have occurred at a number of the quarries. The NRA have been actively involved in highlighting improvement work and some discharge consents have now been issued, enabling the NRA to monitor and regulate any discharges.

Hingston Quarry is situated in an area of historic mining activity and may cut through to old mine workings. Liaison between the NRA and the operators is ongoing.

The County Councils, in their Mineral Plans,^{20, 22} propose investigation into the need and potential for establishing buffer zones between quarries and sensitive other uses. Quarries in the catchment proposed for this treatment are Hingston Down and the dormant quarry at Blackhill, Polyphant. The latter has a working concrete batching plant within it and there are proposals to re-open the quarry workings. A small sandstone quarry at Trewyn, Holsworthy lies between a residential area and the River Deer. A buffer zone is proposed around it by Devon County Council.

4.10 Contaminated Land

Contaminated land is land which could be a hazard to health or cause pollution. It may occur at derelict or existing factory sites or disused waste disposal sites. We are concerned about the water pollution risks from contaminated land.

Our Objective

To prevent the pollution of ground and surface water from contaminated land.

The Role of the NRA

Dealing with contaminated land is complicated. Often a lot of work has to be done to understand the problem fully. Before any action is taken we have to be sure that what is recommended (which can be very costly) will have worthwhile and lasting benefits. We detail our priorities in our 'Contaminated Land and the Water Environment Report' where we also describe some things we can do to tackle the problem. Planning authorities also have powers that they can use. We can:

- * comment on planning applications and give advice on the best way to redevelop sites
- * help to identify contaminated areas
- * help to ensure that the worst sites are dealt with in the most appropriate manner; left undisturbed, targeted for redevelopment or clean up plans prepared
- * take enforcement action if contaminated land is causing pollution.

4.10.1 Local Perspective

Historic development within the catchment has left areas of contaminated land. Most contaminated areas are associated with mineral extraction and ancillary industries. For example around the Gunnislake area at the Greenhill Works near Chilsworthy and Devon Great Consols, both of which processed arsenic. The sparse re-vegetation of these sites reflects their toxic nature. Disturbance of the ground could release potential pollutants to nearby watercourses. There is particular concern for the public water supply abstraction point at Gunnislake which is close downstream to such sites.

Contaminated land already causes high metal levels in the Lower Tamar though current levels in water are not threatening public health. We have no plans for work in the catchment other than ongoing monitoring and development control through the planning process.

The Regional Mines Database project has catalogued areas involved in mineral extraction so that:

- when planning applications are made the potential for contamination and water quality problems can be identified
- when further resources are available, particularly problematic sites, or types of site can be targeted for work to reduce pollution
- if continuing research generates appropriate solutions, sites, or types of site, can be targeted.

CATCHMENT USES

Caradon District Council is compiling a database of areas of possible contaminated land, based on categories given in the Department of Environment consultation document of May 1991. Sites identified in the database are not precluded from redevelopment, but are identified as requiring prior investigation. The NRA is liaising with Caradon over the database and will be consulted on individual planning applications.

Localized groundwater pollution can often be expected in the vicinity of contaminated sites. While not generally documented such pollution is undoubtedly present locally at many sites within the Tamar Catchment. However the overall proportion of groundwaters affected is likely to be small.

Planning permission was granted in 1990 for 1 ton of arsenic sand to be removed annually from metalliferous mine tailing tips at Devon Great Consols for 10 years. Conditions have been put on the permission to minimize disturbance of the most sensitive areas near the river. However, in addition, permitted development rights exist within the General Development Order 1988 (GDO) to remove *de minimis* (the minimum) quantities of mining spoil after notifying the appropriate planning authority. A request has been made to review the GDO whereby local people remove waste at Devon Great Consols as the materials and the site are highly contaminated.

The area around the former Greenhill Arsenic Works, Skinners Shaft and Gunnislake Clitters is being proposed by Caradon District Council for a Derelict Land Grant. This area has extensive mines, mining spoil tips, abandoned arsenic works and other industrial processing such as brickmaking on a steeply sloping site running down to the River Tamar.

Mine Waste Tip Study - Gunnislake area

In 1989 Wardell Armstrong carried out a survey on the pollution risks from mine waste tips in the Gunnislake area, including Gunnislake Clitters and the Devon Great Consols group.²⁹ This was undertaken by considering three aspects:

- stability and erodibility of the tips
- continuity of drainage between the tips and the River Tamar
- the hazard due to the metal contents of the tip

Each site was given an overall 'risk assessment' rating ranging from 'low' (a well vegetated tip, gently sloped and largely free from surface water erosion) to 'very high' (where severe erosion is occurring along with steep, potentially unstable slopes). Spoil tips, or combinations of spoil tips, assessed as 'high' or 'very high' risk included:

'Very High' risk:	Gunnislake Clitters mine Wheal Anna Maria Bedford United mine
'High' risk:	Wheal Maria and Wheal Fanny group North Dimson

CATCHMENT USES

Two types of pollution risk were identified:

- * continual and regular erosion and leaching from the mine spoil tips
- * sudden failure of a tip and the subsequent sedimentation and release of potential contaminants to the water course.

The report gave recommendations for:

- * interim measures: restricting access and removal of material and careful felling of adjacent woodland to minimize disturbance and sudden changes in hydrological conditions.
- * further investigations: water quality monitoring, geotechnical investigations and leachate studies leading to options for;
- * possible remedial work: modifications to the slope, covering surface and revegetation to stabilize the tips and interception of tip runoff/drainage. These solutions are expensive and need to be studied in context with wider issues such as the ultimate land use.

Until such time that investigative and remedial work can be correctly carried out the NRA considers that the tips are best left undisturbed.

Map 14 - Abstractions



4.11 Abstraction and Water Supply

This section considers the abstraction of water from the surface or below the ground for public water supply, industry and other uses.

Our Objective

To manage water resources to secure the best use of water whilst having regard to the needs of the environment and those of abstractors.

The Role of the NRA

Under the 1991 Water Resources Act the NRA has a duty to conserve, redistribute, augment and ensure the proper use of water resources in England & Wales, whilst conserving and where possible enhancing the environment. The legislation provides the NRA with powers to:

- * regulate the abstraction of water by water companies and other users through a licensing system
- * protect surface and groundwater sources from pollution

NRA Policies & Activities

The NRA has adopted a range of key policies in order to fulfill its statutory duties. Foremost amongst these are:

- * **Sustainable Development:** Ensuring that there will be no long-term deterioration in the water environment due to water resources development and use
- * **Precautionary Principle:** Making sure that decisions made and measures implemented err on the safe side of caution if significant environmental damage may occur, or if knowledge on the matter is incomplete
- * **Demand Management & Better Use:** Ensuring due attention has been given to the management and conservation of water resources by measures to control waste and manage demand and to make best use of existing resources, before licensing the development of additional sources.

In order to carry out its statutory duties more effectively, the NRA is currently undertaking a range of activities including:

- * Developing and implementing a nationally consistent approach to the determination of abstraction licences
- * Working on ways of setting Environmental Quality Standards to help in the determination of abstraction licences
- * Working on developing minimum ecologically acceptable flow requirements to help in the determination of abstraction licences
- * Developing a system for mapping the availability of groundwater
- * Defining source protection zones to protect resources from development and pollution risk.

CATCHMENT USES

4.11.1 Local Perspective

Current licensed abstractions

In the Tamar catchment there are currently 24 licensed surface water and 459 licensed groundwater abstractions. The authorized annual total of water which can be abstracted from the catchment is 171,478 Megalitres/year, 170,563MI from surface waters and 915MI from groundwater sources (1MI = 1 million litres). These authorized totals reflect the hydrogeology of the catchment, which is characterized by rocks with very limited groundwater storage (see Section 3.1). As a result there is a large dependence upon abstraction from surface sources, namely rivers and reservoirs.

On average, the total resource available from the Tamar Catchment is approximately 659,000MI/year. The authorized gross total of water which can be abstracted from the catchment (171,478MI/year) amounts to 26% of the available resource, though this is a distortion of resource consumption since some is returned to the catchment. At the catchment scale the available resource far exceeds the nett abstracted quantity, but at the local level this loss can be significant. At some locations individual abstractions may impact on river flows to a significant level. These "low flow sites" are discussed further in section 5.2.3.

Abstractions for public water supply and private water supply (spray irrigation, fish farming and industry/commerce) are considered in more detail below (see also Section 4.6, Aquaculture).

Public Water Supply

Public water supplies are provided by South West Water Services Limited (SWWSL). The company holds 3 surface water abstraction licences in the Tamar Catchment with an annual authorized volume of 86,524MI/year. This represents 13% of the total resource and 50% of the annual licensed volume for the whole Tamar Catchment. There are no groundwater public water supply abstractions in the catchment.

The public water supply abstractions within the Tamar Catchment are strategic sources which meet local needs and supply adjacent catchments. Abstraction from the Tamar Catchment by SWWSL is dominated by the Roadford Strategic Supply System. The Upper Tamar Lake supplies water to parts of North East Cornwall. These abstractions are major losses to much of the freshwater Tamar Catchment as a large proportion is returned at the lower end of the river or to rivers outside the catchment. Supplies for the Launceston area are imported from an abstraction on the Withybrook at Bastreet in the adjacent Lynher Catchment.

Roadford Strategic Supply System

Roadford Reservoir was built to meet the rising demands forecast in Plymouth, South West Devon and North Devon until well into the 21st century. Roadford followed Wimbleball and Colliford as the third strategic reservoir in Devon and Cornwall.

The Roadford Strategic Supply Zone covers a large part of Devon as well as North East Cornwall (see Map 15). The zone is served by a complex water resource system containing 3 reservoirs (Roadford, Meldon and Burrator) and abstractions from the Rivers Tamar, Tavy, Dart and Taw. The conjunctive use of all these sources provides supplies of water to Plymouth, South Hams and Torbay as well as Bideford, Barnstaple and parts of North East Cornwall. Descriptions of the associated sources outside the Tamar catchment are presented in Appendix E.

CATCHMENT USES

During wet periods water is abstracted directly from river sources and smaller reservoirs whilst during drier periods these abstractions are reduced or cease altogether and water stored in major reservoirs is used (mainly Roadford).

Reliable yield of the system

Calculation of the reliable yield for the Roadford Strategic Supply Zone is a complex process. The latest data (presented in the NRA's Regional Water Resources Development Strategy ²⁴) shows that the total reliable resource available during a drought would be 326 MI/day. It should be noted that this figure includes yields for the Roadford Supply system sources (described below and in Appendix E) as well as the yields of small, direct local sources such as the Avon, Venford and Fernworthy Reservoirs on Dartmoor. Computer modelling work by the NRA over the next 12 months is planned in a review of the reliable resource available.

Sources in the catchment

Roadford Reservoir

Roadford Reservoir on the River Wolf is the centrepiece of the Roadford Strategic Supply system. With a gross storage of 37,000MI, it is used for direct supply to parts of North Devon (via Northcombe WTW) and to augment the River Tamar for abstraction downstream at Gunnislake. Under the current abstraction licence a maximum of 81.5MI/day (29,747.5MI/year) can be taken for supply to North Devon and a maximum of 148MI/day can be released as augmentation for abstraction at Gunnislake. A compensation flow of 9MI/day is released into the River Wolf throughout the year.

2,273MI of the Roadford storage is reserved as an NRA Fisheries Bank. This volume of water can be used for fisheries purposes to protect and encourage fish migration up the Tamar, Lyd, Thrushel and Wolf at times when natural river flows are low.

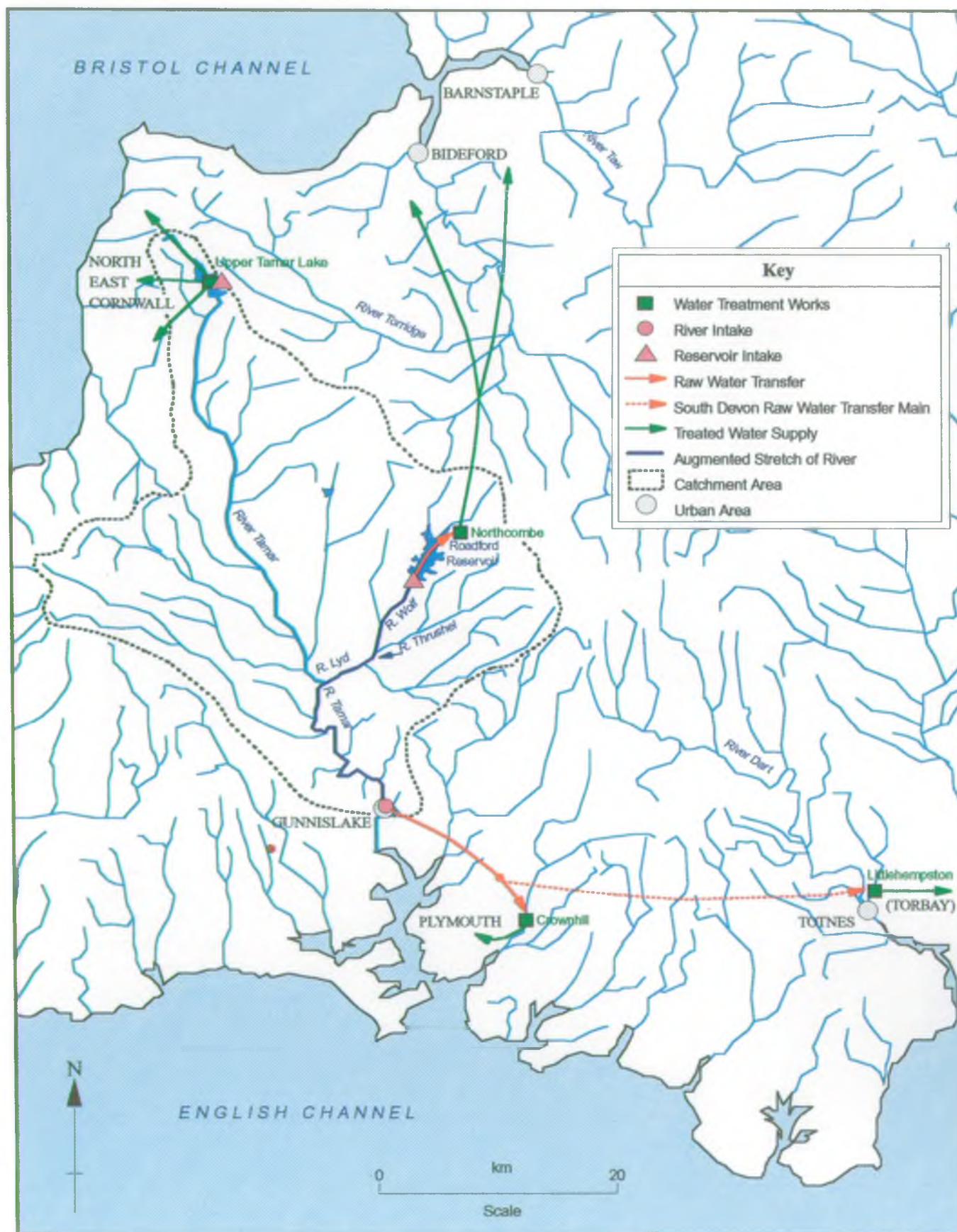
In addition, an Enhanced Flow Programme has been implemented, providing special releases of water during the year to encourage fish migration in the River Wolf, notably migratory trout. This programme makes use of the surplus water in the reservoir available during the early years of the scheme.

Gunnislake river abstraction

This abstraction, located just upstream of the A390 bridge near the tidal limit, operates as both an unsupported and a supported source, governed by a prescribed flow condition. Under the current licence SWWSL may abstract 50% of the available flow above the prescribed flow (as well as any water released from Roadford), up to a licensed limit of 148MI/day (54,020MI/year). When river flows drop below the prescribed level, any abstraction must be wholly supported by releases from Roadford Reservoir. From Gunnislake, water is pumped to Crownhill WTW on the outskirts of Plymouth for treatment and supply to the city. In addition, water can be pumped into a transfer main which conveys untreated water across South Devon to Littlehempston WTW near Totnes, in the Dart Catchment.

The licence originally granted by the Secretary of State for abstraction at Gunnislake, set a prescribed flow at 245 MI/d. However, in an undertaking given to the Tamar & Tributaries Fishing Association at the Public Inquiry in 1978, the then SWWA agreed to operate with the prescribed flow set at a higher level of 477 MI/day for a period of 10 years from 1992. At the end of the 10 year period the water company may apply to the NRA to vary the abstraction licence prior to any change in the prescribed flow.

Map 15 - Water Resources For Public Water Supply



CATCHMENT USES

Tamar Lakes

The Tamar Lakes are situated on the upper reaches of the River Tamar, on the Devon/Cornwall border. There are two lakes, Upper and Lower, though only the Upper Lake is now used for public water supply. It has a usable capacity of 1.335Ml. Water, up to a licensed maximum of 9.09Ml/day, 2,295.76Ml/year, is abstracted direct for treatment at Tamar Lakes WTW before supply to the local area. A compensation release of 2.76Ml/day must be released from the Lake at all times. The reliable resource available during a drought is 6.3Ml/day (NRA Regional Water Resources Development Strategy ²⁴).

Private Water Supply - Other abstractors

Agriculture

The largest number of licences in the catchment are for agriculture, reflecting the importance of this activity in the catchment. Most of these are for small volumes, some agricultural abstractions also fall into the category exempt from licensing.

Industry

This use has the highest nett annual resource commitment of private abstractors. Direct industrial abstractions are operated by two creameries (at Lifton and Davidstow) and by quarries. Most businesses obtain their water supply from the mains.

Domestic supplies

In a rural area such as the Freshwater Tamar Catchment many private dwellings do not have a mains supply and rely on private domestic supplies from groundwater. Many of these are small in quantity (less than 20m³/day) and therefore exempt from licensing control.

Other uses

Apart from one spray irrigation licence, other users return most, if not all, water used back to rivers. Hydropower is the largest of this type followed by fish farming.

Predictions for these uses of water are made in section 5.2 but only as an indication of likely trends. In practise the individual user would have to apply for an abstraction licence if more water was required.

Nett Resource Commitment

Commitment to private water resources in the Tamar Catchment, as defined by licensed authorizations totals amounts to over 84,969Ml/year (13% of the total resource available). However, in reality, many abstractors take less than their authorized quantity and abstracted water is often returned to the catchment (e.g. fish farming 0% nett use) and is available for re-use. It is the nett resource commitment which is of most relevance when considering the water "lost" to the catchment through abstraction.

Table 10 shows for each private abstraction purpose the number of licensed uses, authorized quantities and the approximate nett resource commitment. The total nett resource commitment for private use in the Tamar Catchment amounts to 786Ml/year, only a fraction (0.12%) of the total resource available.

CATCHMENT USES

Table 10: Nett private licensed resource commitment in the Tamar Catchment

Abstraction Purpose	Ground Or Surface Water	Number Of Licensed Uses ¹	Authorized Quantity (ML/year)	Proportion Of Abstraction Not Returned	Net Resource Commitment (ML/year) ²
Agriculture (excl. spray irrigation)	Ground	438	623.8	25%	156.0
	Surface	3	231.6		57.9
Spray Irrigation	Ground	1	1.8	100%	1.8
	Surface	1	0.1		0.1
Fish Farming	Ground	0	0	0%	0
	Surface	5 ³	888.8		0
Industry	Ground	7	258.7	30%	77.6
	Surface	6	1603.8		481.1
Hydropower	Ground	0	0	0%	0
	Surface	5	80371.9		0
Other Private Water Supply	Ground	55	45.3	25%	11.3
	Surface	0	0		0
Amenity Leats	Ground	0	0	0%	0
	Surface	3	943.6		0

1. A site may have a number of licensed uses covered by just one issued licence.

2. Nett Resource Commitment = Authorized Quantity x Proportion Of Abstraction Not Returned.

3. One fish farm holds 2 licences. One fishery (distinct from fish farm in 4.6) also holds a licence.

4.11.2 River flow protection

River flows are normally protected from the impacts of abstraction by the inclusion of prescribed flow conditions in abstraction licences. These prescribed flows are often set with reference to some statistical measure of low flow such as Q95 (the flow equalled or exceeded for 95 % of the time, on average), with an additional allowance to protect other legal users downstream.

In the past there has been difficulty achieving agreement in the scientific community on a suitable objective measure for environmental protection. Nationally the NRA is currently investigating methods for implementing statutory "minimum acceptable flows" and is concurrently studying ways of assessing scientifically the habitat needs of a range of aquatic species.

Where investigations confirm that river flows have declined to an unacceptable level due to licensed abstraction, possible solutions will be promoted. In some instances it will be appropriate to restore flows to a more reasonable level. This could involve varying existing abstraction licences or introducing better management practices. 4 low flow sites were identified in the catchment, only one of which was identified for immediate investigation (see Section 5.2).

4.12 Effluent Disposal

Here we consider the disposal of effluent directly to rivers, estuaries, the sea or into the ground. Effluent includes sewage, industrial and farm wastes. We regulate the disposal of effluent by issuing consents to control discharges and by taking action if a river is accidentally polluted.

Rivers have a natural ability to render the main constituents of many effluents harmless, providing that effluent disposal is properly controlled.

Our Objective

To protect the water environment from harm caused by the disposal of effluent and allow the widest possible use to be made of rivers.

The Role of the NRA

We have duties and powers to:

- * authorize discharges through a system of consents. It is illegal to discharge sewage effluent or trade waste without the consent of the NRA. Before making a discharge it is necessary to apply for a consent. We look at the circumstances in each case. We can refuse a consent if a discharge will cause an unacceptable deterioration in water quality.
- * check discharges to see if they comply with consent standards. We may prosecute dischargers if they exceed consent conditions.
- * prevent illegal discharges.
- * direct investment in sewerage and sewage treatment by the water companies in line with AMP2 guidelines (see section below on **Improvements to South West Water Services LTD (SWWSL) Discharges**).

We are involved in a range of activities:

- * we work with planning authorities to control development where the sewerage or sewage treatment system is overloaded.
- * we liaise with trade dischargers, farmers and SWWSL, carry out regular site inspections and monitor discharge quality.
- * we constantly review and develop our approach to water sampling.

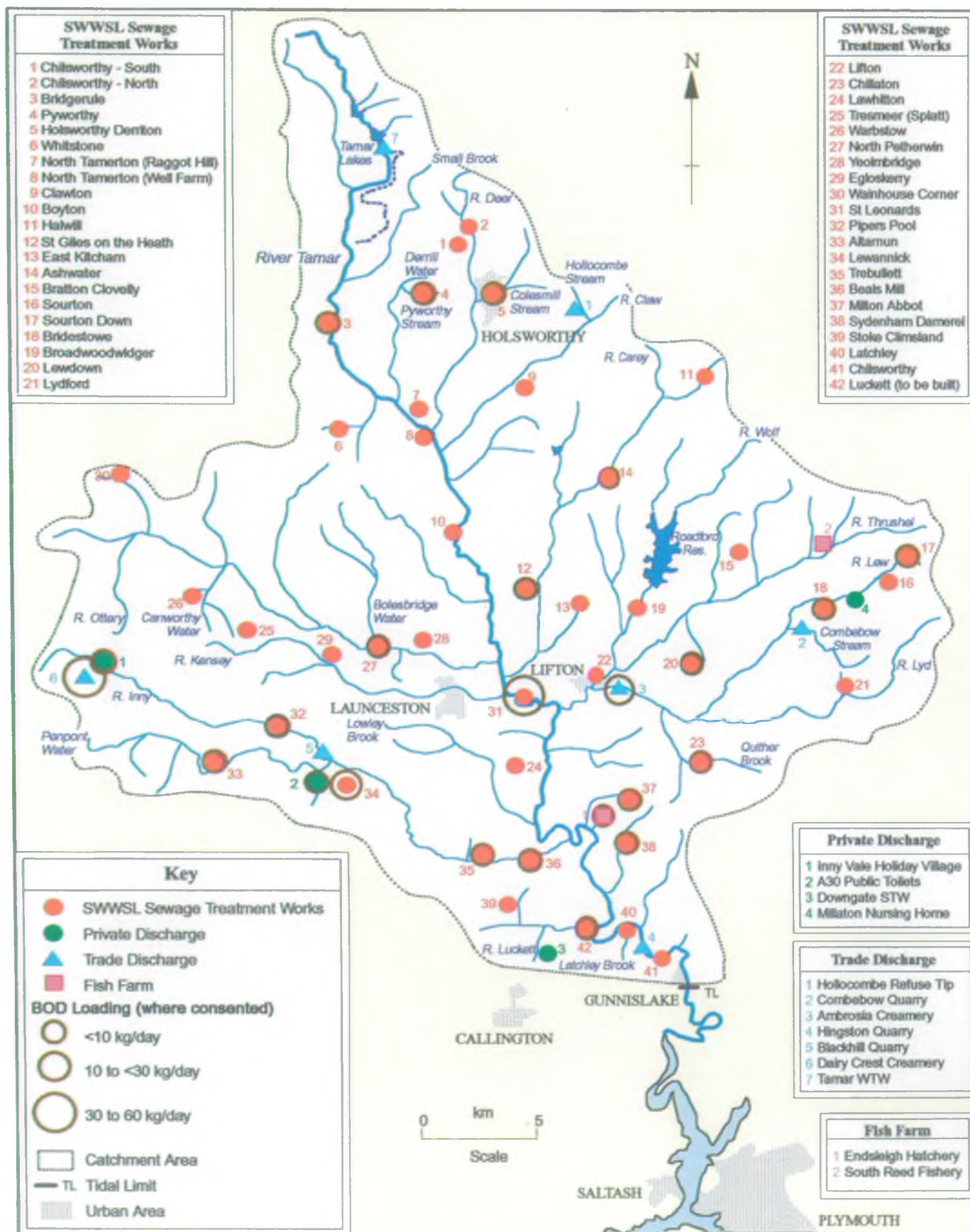
Improvements to South West Water Services LTD (SWWSL) Discharges

Improvements to SWWSL's discharges over the next 10 to 15 years are subject to available funding approved by OFWAT, the water industry's economic regulator. A Strategic Business Plan, (Asset Management Plan 2 (AMP2)), for these schemes was developed based on guidelines agreed between the NRA, Department of the Environment (DoE), Water Services Companies and OFWAT. The plan was submitted to OFWAT early in 1994.

In order of priority, schemes included are:

- 1) schemes required to meet and maintain **current** EC and domestic statutory obligations
- 2) schemes required to meet and maintain **new** EC and domestic statutory obligations
- 3) schemes which already have been separately justified, required to maintain river quality relative to the 1990 NRA survey of water quality or to achieve river or marine improvements.

Map 16 - Effluent Disposal



CATCHMENT USES

OFWAT declared the associated customer charging base in July 1994. However, no commitment to the delivery of the environmental programme can be given by SWWSL until their request for a review by the Monopolies and Mergers Commission (MMC) is completed. It should be emphasized, therefore, that the improvements by SWWSL, identified for the Tamar Catchment under AMP2, are provisional until a commitment is established. The timing of any improvement works will depend upon a priority rating system agreed between SWWSL and the NRA. Details of individual works will not be known until after the completion of the MMC review.

4.12.1 Local Perspective

Discharge consents only apply to point source discharges, that is to say, specific, identifiable discharges of effluent from a known location. Diffuse sources of pollution, such as agricultural runoff, and pollution incidents, such as accidental spillages, cannot be controlled by discharge consents.

There are two types of consented discharges in the catchment:

- **Continuous** from sewage and trade wastes.
- **Intermittent** from storm sewer overflows and emergency overflows.

These are either discharges to ground or surface waters.

Continuous Discharges

Within the catchment there are 44 SWWSL sewage treatment works of which 20 are small works which receive no trade effluent and have descriptive consents, where no numerical quality standards are imposed. The others have conditions for sanitary parameters.

There are 4 consented private sewage treatment works, none of which is of significant volume.

The past, current and projected proportion of population on mains sewerage systems are given below (Source: SWWSL, Forward Planning Dept.).

Table 11: Percentage of population on mains sewerage

1989	1992	Projected 2011 (low forecast)	Projected 2011 (high forecast)
62.6%	65.8%	72.5%	74.7%

Table 11 shows there are, and will continue to be, a significant proportion of private discharges. The National policy is to discourage the proliferation of small private treatment plants in favour of mains connections.

Upgrading of old inefficient works has been carried out throughout the catchment in recent years, such as the new plant now serving Launceston and surrounding villages.

CATCHMENT USES

There are currently 11 NRA recommended areas of development constraint (see Section 4.7) in the catchment. These are where sewage treatment works (STWs) are not complying with their consents, are having an environmental impact on receiving waters or are causing EC Directive failure. Development Restraints are requests by the NRA to Planning Authorities to prevent development which would require connections to mains sewerage systems where this would exacerbate an existing problem.

Industry

There are 8 consented trade discharges in the catchment, 3 from the two creameries, 3 from quarries and 2 from fish farms.

The following locations failed discharge consent assessment during 1994:

Stoke Climsland STW	Pipers Pool STW	Pyworthy STW
Holsworthy STW	Sourton Down STW	Inny Vale Holiday Village
Endsleigh Hatchery	Dairy Crest Creamery, Davidstow	
Blackhill Quarry	Millaton Nursing Home	

Intermittent Discharges

There are numerous intermittent discharges in the catchment, for example storm sewer overflows. There are no significant problems known of in the catchment.

Pollution Events

Table 12: Pollution incidents arising from industrial and sewage effluents 1992 to 1994.

Pollution Incidents	Major	Significant	Minor
Industrial			
1992	1	2	19
1993	0	3	14
1994	0	4	8
Waste Water Treatment			
1992	0	1	20
1993	0	1	32
1994	0	1	23

Note: Definitions of Severity Codes are given in Appendix F.

Urban Waste Water Treatment Directive

Altamun STW and Lewannick STW are identified under AMP2 as requiring appropriate treatment under UWWTD.

Consents are reviewed as required on a basis of perceived environmental effect or changes in flows. Development pressure sometimes requires whole-catchment reviews to provide capacity for discharges, however none are presently planned in the catchment.

4.13 Waste Disposal

Here we consider the disposal of waste to land. Some wastes can form very polluting liquids - known as leachate - as they break down. Leachate can pollute water both above and below ground.

Waste disposal sites are licensed by the County Waste Regulation Authority who make sure that sites do not endanger public health, cause pollution or spoil the local area. Waste Regulation Authorities consult us on all applications for waste disposal licences and we recommend ways of avoiding water pollution to them; we also advise Waste Regulation Authorities on the effects of some activities that are exempt from licensing controls. We have published our views on landfill in our 'Position Statement on Landfill and the Water Environment'.²⁵ In this statement we encourage waste minimization and recycling.

Some potentially polluting wastes can be spread on farmland to improve the soil. We advise the Waste Regulation Authority on ways of protecting the water environment from this activity.

Our Objectives

To prevent the pollution of ground and surface water or damage to wetlands caused by the disposal of waste to land.

The Role of the NRA

We have duties and powers to:

- * monitor the quality of water around waste disposal sites
- * take enforcement action if pollution occurs.

Our work involves a range of activities:

- * we work with planning authorities to make sure that new landfill sites are put where they will not cause pollution of water by commenting on Waste Local Plans
- * we ensure that site operators make plans to monitor water and prevent pollution when they apply for a new site licence
- * we help to make sure that sites are maintained and operated properly.

4.13.1 Local Perspective

There are two sites in the catchment, Anvil Corner and Combebow Quarry, licensed for inert and putrescible waste (organic waste which will rot). The leachate (liquid from rotting waste) generated from such sites contains high levels of BOD and Ammonia. Both sites have histories of causing pollution problems to nearby watercourses. Anvil Corner Landfill consists of in-filled disused reservoirs. It was investigated by the NRA in 1993 as high concentrations of ammonia and BOD were found in the Hollocombe Stream downstream of the tip. The area for spray irrigation was found to be inadequate for the volume of leachate. The leachate is now tankered to Bude Waste Water Treatment Works.

Map 17 - Waste Disposal



CATCHMENT USES

Combebow Quarry was investigated by the NRA in 1993. Water from the spring on the site contained high ammonia concentrations, particularly following wet weather, probably arising from overloading of the spray irrigation area. However, there has been no impact on water quality in the receiving water course. The pollution is found to be related to spray irrigation carried out on the un-lined western side of the tip. When leachate irrigation is moved to the lined eastern side of the site the ammonia in the spring is reduced.

There are six sites licensed for inert and semi-inert waste within the catchment. These do not cause any known problems. There are four scrapyards in the catchment.

There are 19 closed sites, of which 11 are to be found along the Thrushel valley and were licensed to take construction material from building the new A30. There are a number of small unlicensed sites, often old quarries, throughout the catchment, usually used for domestic waste. Most of these have been closed for 10 to 15 years and have had time to stabilize. There are no known impacts on ground or surface waters but potential pollution problems can occur if new development causes disturbance.

5.0 TARGETS AND STATE OF THE CATCHMENT

In this section we assess the state of the catchment by looking at four aspects of the water environment:

- * Water quality
- * Water quantity
- * Physical features
- * Flood defence.

We identify environmental quality targets where we can. Our success at reaching these targets is one way that we can comment on the state of the catchment.

Key

- Compliant with Proposed WQO
- Non-compliant with Proposed WQO (Marginal Failure)
- Non-compliant with Proposed WQO (Significant Failure)
- Not Monitored
- (1996) Target Date for Compliance
- Stretch Boundary
- RE1-RE5 River Ecosystem Target Class
- Catchment Area
- Urban Area
- TL Tidal Limit

TARGETS & STATE OF THE CATCHMENT

5.1 Water Quality

The NRA aims to maintain and improve where appropriate the quality of water for all those who use it. This is achieved by setting targets/standards for water quality based on:

- Water Quality Objectives to protect recognized uses.
- Ensuring compliance with the standards laid down in EC Directives
- International commitments to achieve reductions in inputs of Annex 1A substances to UK tidal waters

Comparison of the "current state" of water quality in the catchment with the targets will enable issues to be identified. In addition, some water quality issues have been identified through monitoring which is over and above that associated with water quality objectives or the requirements of EC Directives or Annex 1A reductions.

5.1.1 Water Quality Objectives

Introduction

The Water Resources Act 1991 contains legislation which allows the Secretaries of State to prescribe classification schemes for water quality and to use them for the setting of Water Quality Objectives (WQOs). Previous references to water quality have been based on the National Water Council (NWC) classification system. The NWC system was interpreted subjectively and had a limited range of chemical parameters, therefore it has been replaced with a dual system of use-related classifications and a general quality assessment (GQA) system. These reporting facilities will operate in parallel and will represent a neutral translation in standards from the NWC scheme. Whilst the WQO system will examine compliance with specific use-related standards, the purpose of the GQA is to make periodic assessments of river water quality in order to monitor geographical and temporal trends.

A Use-Related Scheme

The Classification Scheme proposed for establishing WQOs is based upon the recognized uses to which a river stretch may be put. These uses include River Ecosystem, Abstraction for Drinking Water Supply, Agricultural Abstraction, Industrial Abstraction, Special Ecosystem, and Watersports. The first phase of WQO implementation will be restricted to the River Ecosystem Use Class⁴⁰ only; the standards for further uses are still under development. For each stretch, a WQO River Ecosystem Use Class will be proposed, including a date by which this level of water quality should be achieved. Until WQOs are formally established by legal notice served by the Secretary of State, they will be applied on a **non-statutory** basis through a neutral translation of River Quality Objectives (RQOs) from NWC classes to appropriate WQO RE classes with target dates for compliance. In some cases it may be desirable to improve the WQO for a particular stretch relative to its previous RQO (i.e. the translation from RQO to WQO would not be neutral). This would typically occur where clear actions can be identified to bring about further river quality improvements. Occasionally a WQO may be set which is less stringent than the previous RQO. This occurs when the old RQO is felt to be unrealistic for the stretch.

River Ecosystem Use Class

The standards defining the five tiered River Ecosystem (RE) use classes were introduced by *The Surface Waters (River Ecosystem) (Classification) Regulations 1994*.⁴⁰ The term "River Ecosystem" is used in recognition of the need to protect the ecosystem that is sustained in a healthy river. The standards for the five RE classes (contained in Appendix C, Table C1) are based on the chemical water quality requirements of different types of ecosystem, and consequently the types of fisheries they are capable of supporting.

TARGETS & STATE OF THE CATCHMENT

"Set Aside" of Data

The document "Water Quality Objectives: Procedures used by the National Rivers Authority for the purpose of the Surface Waters (River Ecosystem) (Classification) Regulations 1994"⁴⁰ provides for setting aside of data for pH and metals where local geology is responsible for non-compliance. Current and historical data shows that in order to protect the good water quality indicated by organic determinands in the Tamar Catchment data for pH and metals should be "set aside" at certain sites when assessing compliance.

Water Quality Objectives for the Tamar Catchment

The proposed water quality objectives, "The River Ecosystem Use Classes" for the Tamar Catchment are shown on Map 18. It is proposed that these WQOs will apply from 1995, initially on a non-statutory basis.

In general the objectives set are at least RE2 which is water of good quality, suitable for all fish species. Where the higher RE1 can be realistically achieved this has been set as an objective. RE1 is not a realistic objective for some river stretches, depending on topography, geology and land use.

Specification of RE1 on some stretches receiving effluent discharges cannot be considered at present as the NRA is constrained by national agreements not to impose costs on water companies outside their committed expenditure.

Whilst suspended solids are not contained within the RE classification a significant level of impact throughout the system (ecology and fisheries) has not been demonstrated, see pages 90 -91.

Water quality objectives will apply as from 1st January 1995, except for the following stretches where the WQOs will apply from 1998 to allow improvements to be carried out:

Table 13: River stretches where WQOs will apply from 1998

River	Reach	Reach length (km)
Tamar	Below confluence with River Deer	0.3
Tamar	Netherbridge	1.9
Tamar	Polson Bridge	2.5
Inny	u/s Davidstow Creamery	1.4
Thrushel	Stowford Bridge	5.9
Bolesbridge Water	200m d/s Navarino Bridge	8.0
Bolesbridge Water	Ottery Confluence	1.9

TARGETS & STATE OF THE CATCHMENT

Certain stretches are achieving water quality which is better than their previous NWC RQOs. This improvement may only be recent as in the case of the River Inny Upstream of Davidstow Creamery, but is anticipated to be lasting. Therefore WQOs which are an improvement on the old NWC RQOs have been set for the stretches listed in the table below:

Table 14: River stretches achieving higher water quality than previous NWC RQOs

River	Reach	Reach Length (km)
Lowley Brook	Lowley Bridge	1.8
Lowley Brook	Tamar Confluence (inferred stretch)	0.6
Inny	u/s Davidstow Creamery	1.4
Inny	Trecarrell Bridge	4.6
Inny	Beals Mill Bridge	4.3
Inny	Tamar Confluence (inferred stretch)	2.4
Kensey	Newport	3.3
Kensey	St Leonards Bridge	2.8
Kensey	Tamar Confluence (inferred stretch)	0.1
Lyd	A386 roadbridge, Lydford	6.5
Quither Brook	Prior to River Lyd	6.7
Quither Brook	Lyd Confluence (inferred stretch)	?
Canworthy Water	Prior to River Ottery	4.8
Canworthy Water	Ottery Confluence (inferred stretch)	0.4

TARGETS & STATE OF THE CATCHMENT

In addition, long term WQOs, which represent an improvement compared to the previous NWC RQOs, have been set which represent long term aspirations for water quality within the Tamar Catchment. Long term WQOs are set when investment is currently not available to bring about sustainable improvements to water quality. Long term WQOs have been set for the following stretches:

Table 15: River stretches with long term WQOs

River	Reach	Long Term WQO	Reach length (km)
Colesmill Stream	100m d/s Holsworthy STW	RE2	0.2
Colesmill Stream	Deer Confluence (inferred stretch)	RE2	0.2
River Lew	Combebow Bridge	RE1	8.4
River Lew	Prior to R Lyd	RE1	7.3
River Lew	Lyd Confluence (inferred stretch)	RE1	0.1

There is one stretch on the River Carey, Ashmill Bridge, where a WQO of RE2 has been set which represents a downgrading compared to the old RQO. The WQO has been set at RE2 because it is felt that the old RQO is unrealistic for this stretch, and in fact the WQOs for the rest of the Carey are all RE2 which is consistent with their previous RQOs.

Current State of the Tamar Catchment

An assessment of current water quality based on the River Ecosystem use classes (Appendix C, Table C1) in the catchment has been made using data (held on the Public Register) from the routine water quality sampling programme taken over the three year period 1991-1993 inclusive. A comparison of current water quality with the WQOs shows that there are several stretches where current water quality does not comply with the objectives for those stretches (see Map 18).

Where river quality does not comply with its WQO, but this non-compliance may be due to statistical chance (50-95% confidence of failure), the stretch is described as a marginal failure and coloured yellow on the map. Where the river quality does not comply with its WQO, and this non-compliance is unlikely to be due to statistical chance (>95% confidence of failure), the stretch is described as a significant failure and is coloured red on the map.

Of the 81 classified river stretches in the Tamar Catchment, 1 significantly fails to meet its water quality objective and a further 8 stretches marginally fail to meet their objectives. The reasons for the significant and marginal non-compliance with water quality objectives (WQOs) for individual stretches are discussed on page 83. In addition, those stretches where pH or copper data are "set aside" are also identified.

TARGETS & STATE OF THE CATCHMENT

River Tamar

The stretches 'Below confluence with River Deer', Netherbridge and Polson Bridge marginally fail to comply with their WQO of RE Class 2 due to elevated levels of Biological Oxygen Demand (BOD), however the target date for compliance is not until 1998.

The source of the elevated BOD is considered to be agricultural in nature. During the last few years the NRA has been addressing the problems of illegal farm discharges and land drainage by taking enforcement action and liaising with farmers. However, these are ongoing problems and the NRA is continuing with inspections and enforcement where necessary. The stretch monitored at Polson Bridge was affected by the discharge from St. Leonards STW but this works has now had a new consent issued and has been upgraded. The marginal non-compliance with WQOs is thought to be due to agricultural activity.

Issue 1: The effect of agricultural activity on water quality.

The stretch on the River Tamar monitored at Gunnislake attains RE Class 5 due to elevated copper concentrations. This part of the River Tamar is impacted by extensive past mining activity (see Sections 4.9 and 4.10), though there is currently no evidence of major biological impact. The NRA is unable to undertake remedial measures to address the problem. In the short term as the source of the WQO objective failure (copper) can be reliably identified, if the data is "set aside" then the stretch can be set and achieve RE2, enabling the protection of other determinands (see "set aside" of data, page 80).

Issue 2: The effect of local geology/abandoned mines on water quality.

River Inny

The stretch known as 'Upstream of Davidstow Creamery' (although it actually receives a discharge from the creamery) significantly fails to comply with its WQO of RE Class 1 due to elevated levels of BOD, and marginally fails due to elevated concentrations of total ammonia. This top stretch of the River Inny has been affected by farm discharges, cross-connected drains and the discharge from Davidstow Creamery. Farm schemes have now been installed, the drains properly connected and the Creamery discharge improved, which resulted in an improvement of water quality in 1994. This means that the stretch should be compliant with its WQO of RE1 by 1998 and therefore the significant non-compliance for 1993 cannot be regarded as an issue.

River Lyd

The stretch of the River Lyd monitored at A386 Roadbridge Lydford attains RE Class 5 due to low pH. As the River Lyd rises on Dartmoor this low pH is attributed to naturally occurring acidic runoff. If the pH data is set aside then this stretch achieves its WQO of RE Class 1.

See Issue 6.

River Thrushel

The River Thrushel at Stowford Bridge marginally fails to comply with its WQO of RE Class 2 due to elevated BOD levels which are probably caused by farm runoff during periods of high rainfall. However, the target date for compliance with the WQO is not until 1998.

See Issue 1.

Bolesbridge Water

Bolesbridge Water marginally fails to comply with its WQO of RE Class 2 because of elevated BOD levels which are probably due to farm runoff at times of high rainfall. Recent data indicate that water quality in Bolesbridge water is improving, though the target date for compliance with the WQO is not until 1998. See Issue 1.

Map 19 - EC Directive Monitoring



TARGETS & STATE OF THE CATCHMENT

5.1.2 EC Directives

Introduction

The current state of water quality within the catchment will be compared with targets set by EC Directives appropriate to the catchment. Issues will be identified where standards set out in EC Directives are not being met.

Derogations

Certain parts of the catchment are subject to uncontrollable inputs of trace metals from historic mining and natural geology. Where EC Directive standards (under the EC Freshwater Fish Directive³⁸) for metals are not met due to inputs from natural sources the NRA will recommend a derogation, i.e. the metals component of these standards will not be applied.

EC Freshwater Fish Directive

The Freshwater Fish Directive "on the quality of waters needing protection or improvement in order to support fish life", 78/659/EEC³⁸, is concerned with ensuring that water quality in designated stretches of water is suitable for supporting fisheries. This Directive contains two sets of quality standards, one at levels to support a cyprinid fish population (i.e. coarse fish) and another set at stricter levels to support a salmonid fish population (e.g. salmon and trout). There are two sets of standards for each fishery type, imperative standards which must be achieved, and guideline standards which Member States should aim to achieve (Appendix C, Table C2).

The designation of river stretches and lakes is shown on Map 19. All designated river stretches, including the Upper Tamar Lake, have been designated as salmonid, the only designated cyprinid fishery is the Lower Tamar Lake.

Current state

The EC Freshwater Fish Directive imperative standards were met at all but the following sites: Two Bridges on the Penpont Water where the standard for total zinc was exceeded in 1991. This is considered to be due to local geology. If the standard for total zinc is exceeded in future years then a derogation will be sought. Buses Bridge on the River Tamar failed to comply with the imperative standard for total ammonia in 1994. This is thought to be due to poor agricultural practices within the intensively farmed catchment.

See Issues 1, 2.

EC Dangerous Substances Directive

The Dangerous Substances Directive "on pollution caused by certain substances discharged in the aquatic environment of the community", 76/464/EEC³⁹, is concerned with controlling certain substances considered harmful which are discharged to the aquatic environment. The Directive established two lists of compounds. List I contains substances regarded as particularly dangerous because of their toxicity, persistence and bioaccumulation. Discharges of List I substances must be controlled by Environmental Quality Standards (EQSs) issued through Daughter Directives (Appendix C, Table C3). List II contains substances which are considered to be less dangerous but which still can have a deleterious effect on the aquatic environment. Discharges of List II substances are controlled by EQSs set by the individual Member States (Appendix C, Table C3).

TARGETS & STATE OF THE CATCHMENT

The sites monitored in this Catchment are shown on Map 19. There is a National Network site on the River Tamar at Gunnislake Bridge which is monitored for List I substances. List I substances are also monitored downstream of St Leonards STW in the River Tamar and downstream of Holsworthy (Derriton New) STW in the Colesmill Stream. List II substances are monitored in the River Tamar downstream of Hingston Quarry.

Current state

The Environmental Quality Standards (EQSs) for List I Dangerous Substances have been met at all sites monitored in the catchment since 1991.

In 1993 the EQS for copper was exceeded downstream of Hingston Quarry in the River Tamar. An investigation into discharges in the Lower Tamar was undertaken by the NRA in 1994. Several significant point and diffuse sources of dissolved copper were identified in the reach from Gunnislake gauging station to the mine drainage adit upstream of Hingston Quarry discharge. These sources are from abandoned mine workings and spoil tips adjacent to the discharge. The main point source in dry weather, Clitters Adit, contributes about 40% of dry weather loading of dissolved copper into the river (Hingston Quarry contributed 2%). In wet weather additional point sources from spoil tip runoff contribute to dissolved copper in the River Tamar. In 1993 Hingston Quarry discharge complied with its consent conditions. The location of the sampling point is considered to be within the mixing zone of Hingston Quarry discharge. As a result of NRA investigations the sampling point has been relocated to Gunnislake gauging station to ensure samples are taken outside of the mixing zone. There is no clear link between exceedence of dissolved copper at the sampling point and the discharge from Hingston Quarry discharge. A combination of local geology and historical mining activity in the area causes high background levels of copper. There is concern that future quarrying activity at Hingston may result in a break through into old mine workings and a subsequent release of metal contaminated water.

The NRA has concerns that disturbance of historic mine spoil heaps at Devon Great Consols could potentially release heavy loadings of metals into the Lower Tamar. A report by Wardell Armstrong in 1990²³ was commissioned by the then South West Water Authority. (see Section 4.10, Contaminated Land).
See Issue 2.

EC Surface Water Abstraction Directive

The Directive "concerning the quality required of surface water intended for the abstraction of drinking water in the Member States" (75/440/EEC)⁴¹, ensures that surface water abstracted for use as drinking water meets certain standards and is given adequate treatment before entering public water supplies. The Directive sets out imperative standards which must be achieved, and guideline standards which Member States should aim to achieve, for water for public supply which is to be given different levels of treatment (Appendix C, Table C4). There are three surface water abstraction points in the Tamar Catchment: Upper Tamar Lake, Roadford Reservoir and the River Tamar at Gunnislake. These are shown on Map 19.

Current State

All sites were within the standards for 1991 and 1993. In 1992 the River Tamar at Gunnislake met the standards, however Roadford Reservoir exceeded the standard for dissolved and emulsified hydrocarbons, and at the Upper Tamar Lake one sample out of four exceeded the standard for phenols.

TARGETS & STATE OF THE CATCHMENT

We are currently concerned about the suitability of the methods for the analysis of phenols and dissolved and emulsified hydrocarbons specified in the Surface Water Abstraction Directive. Exceedences of the Directives standards cannot always be attributed to polluting discharges, and the NRA suspects that some exceedences may be due to natural compounds resulting from the breakdown of vegetation. We are involved in discussions with the Department of the Environment, with a view to improving the analytical methods used.

EC Urban Waste Water Treatment Directive (UWWTD)

The EC Directive "concerning urban wastewater treatment", (91/271/EEC)⁴² lays down minimum standards for the provision of sewage collection systems and sewage treatment. The Directive specifies secondary treatment for all discharges serving population equivalents greater than 2000 to inland waters and estuaries, and greater than 10,000 to coastal waters, but provides for higher standards of treatment for discharges to "sensitive" areas and lower standards of treatment to "less sensitive" areas. Sensitive areas are those surface waters which receive discharges serving population equivalents of greater than 10,000, and are or may become eutrophic in the near future. Discharges below the specified population equivalents for inland and estuaries and coastal waters must also receive "appropriate" treatment as defined in the Asset Management Plan 2 Guidelines (AMP2 Guidelines, Version 2, Approved by the Quadripartite Meeting, 14/12/93).

Current state

Altarnun STW and Lewannick STW have been identified under AMP2 as requiring appropriate treatment under the UWWTD. No river stretches in the Tamar Catchment have been identified as "sensitive areas" or as requiring further monitoring to establish their status under the UWWTD.

EC Groundwater Directive

Whilst the EC Groundwaters Directive controls the release of certain substances to groundwaters, there are no statutory standards for groundwater quality. The NRA can only compare water quality with appropriate standards for the 'use' to which groundwaters are put. However there is no compulsion for the NRA to ensure that groundwater quality achieves desirable use standards.

The NRA considers that groundwater quality within the catchment is generally reflected by river water quality during dry weather periods when river flow is almost entirely derived from groundwater seepage. Within the catchment this indicates that groundwater quality is likely to be generally suitable for providing river baseflow and supporting identified river water uses, except in areas disturbed by mining activity.

A small number of borcholes in the catchment have been sampled but no conclusions about general groundwater quality can be drawn.

A key element to assist the protection of groundwater generally is identifying areas which are particularly vulnerable according to properties of the soil cover and the underlying rocks. A programme of Groundwater Vulnerability mapping is well underway and will assist in future pollution prevention planning.

TARGETS & STATE OF THE CATCHMENT

Groundwater Protection Policy

The protection of aquifers from pollution is of great importance, as the contamination of groundwater may put water supplies at risk. Contamination may also impact on river water quality where the baseflow depends on groundwater. If groundwater becomes polluted it is not easy to detect and is very difficult and expensive to clean up again. So it is better to prevent or reduce the risk of groundwater contamination in the first place rather than deal with the consequences.

In 1992 we published our Policy and Practice for the Protection of Groundwater¹⁶(PPPG). This is a national policy which ensures that there is a consistent approach to the prevention of groundwater pollution. The policy document sets out why we must safeguard the quality and flow of water in aquifers and outlines how the NRA with the co-operation of other organisations and individuals will work to reduce risk of groundwater pollution.

The PPPG statements cover the risks posed by various activities based on the type of aquifer, its vulnerability and, in the case of drinking water sources, the proximity to that source.

Our Policy document contains policy statements on the following :

- Control of Groundwater Abstractions
- Physical disturbance of aquifers affecting quality and quantity
- Waste disposal to land
- Contaminated land
- Disposal of sludges and slurries to land
- Discharges to underground strata
- Diffuse pollution
- Other threats to groundwater quality

The full policy document is available from HMSO. A summary guide outlining NRA concerns and how they may be addressed is shown in Appendix G.

Catchment Management Plans need to address the importance of pollution prevention planning in achieving and maintaining future groundwater, as well as freshwater, quality.

Within the Tamar Catchment the particular threats to groundwater are thought to be from agriculture (sprays, fertilizers and animal wastes) and other activities involved in the application of sludges and slurries to land. The NRA seeks to control this through the promotion of the Code of Good Agricultural Practice¹⁷ and through liaison with statutory undertakers such as Her Majesty's Inspectorate of Pollution and Waste Regulation Authorities. In the future we will be merged into the Environmental Agency and deal with such matters as one agency. Mining and the contaminated land associated with it poses threats in the lower section of the catchment. The only controls available to counter such threats is through the Planning Process and negotiations with developers. We work with Planning authorities to minimize the risks posed to groundwater from development and land use changes.

We have mapped the vulnerability of groundwaters in England and Wales and the Tamar Catchment is classed as a "minor aquifer". We are working on a more detailed classification and the results of this work will be published in 1998.

TARGETS & STATE OF THE CATCHMENT

ANNEX 1A Reduction Programme

At the second and third North Sea Conference, the UK Government made a commitment to reduce the loadings (concentration x flow) of certain substances ('Annex 1A' substances) (Appendix C, Table C5) entering tidal waters from rivers and direct discharges⁴³. Loads of most Annex 1A substances are to be reduced by 50%, but loads of mercury, cadmium and lead are to be reduced by 70%. Reductions are to be achieved by 1995 compared to a 1985 baseline, or a 1991/1992 baseline where data for 1985 is unavailable. In England and Wales the NRA is responsible for identifying inputs where reductions must be made in order to meet this commitment. Riverine and direct discharge inputs are ranked according to size of load, and those inputs which contribute to 95% of the loadings of Annex 1A substances entering tidal waters are said to be significant.

The River Tamar at Gunnislake is monitored for Annex 1A purposes.

Current State

Significant loads of mercury, cadmium, copper, zinc, lead, chromium, nickel and arsenic have been recorded in the River Tamar at Gunnislake during the period 1991-1993. These high loads of metals, particularly copper and arsenic, can be attributed to inputs from the old mining area just upstream of the Gunnislake monitoring site. Mine waste tips in the area could cause significant pollution in the future, by further affecting general water quality of the River Tamar and also possibly having a detrimental effect on South West Water Services Ltd potable abstraction point at Gunnislake. Parts of the old mining area are now forested and future forestry activities and vehicular access could increase surface water runoff and exacerbate erosion and instability.

See Issue 2.

In the River Tamar at Gunnislake significant loads of gamma HCH (an organochlorine insecticide) were recorded in 1991, 1992 and 1993. In 1992 significant loads of trifluralin (an organochlorine herbicide) and endrin (an organochlorine insecticide) were recorded, and in 1993 there was also a significant load of hexachlorobenzene. As the Tamar is a farming catchment it is not surprising that herbicides and pesticides are detected at Gunnislake. However, endrin was banned from use in 1984 and hexachlorobenzene from use as a pesticide in 1975. It should be noted that these herbicides and pesticides are present in low concentrations, however because of the large flow of the River Tamar the loads (concentration x flow) are significant.

There was a significant load of organotin measured at Gunnislake in 1991. The type(s) of organotin present in the river at Gunnislake in 1991 is unknown. Organotin, in the form of triphenyltin is used as a fungicide and acaricide. It is also possible that the organotin was present in the form of dibutyltin which has a low toxicity and so would not be a cause for concern. There was also a significant load of tributyltin recorded at Gunnislake in 1993, however this was due to only one positive result recorded in the year.

Issue 3: Following national compilation of data, investigations may be required to determine the source of these Annex 1A organic substances and reductions in loads may have to be sought.

TARGETS & STATE OF THE CATCHMENT

5.1.3 Additional Monitoring

Tamar Lakes

Preliminary investigations of the Upper Tamar Lake suggest that it is eutrophic (nutrient rich). This could have implications for the water supply from the reservoir.

On a few occasions blooms of toxic blue-green algae have occurred in the Tamar Lakes. In very rare instances these blooms have migrated down the Tamar. If this should recur the NRA would investigate control mechanisms and inform relevant external organisations such as MAFF and local council Public Health departments. Further work is required to assess the trophic state of the Tamar Lakes.

The results of qualitative investigations of macrophyte growth in the Tamar Catchment may be indicative of eutrophication. Further work is required to assess the trophic state of the Catchment.

Issue 4: a. Eutrophication of the Tamar Lakes.

b. Possible eutrophication within the Tamar Catchment

Suspended Solids

There is some evidence that the River Tamar carries high loads of suspended solids.

Impacts

There is no evidence of significant impact throughout the catchment, though there may be localized impacts. Studies have identified that fine sediments can significantly impact on salmonid embryo survival rate in spawning gravels (see NRA R&D project 152 on the Torridge). Higher levels would also have implications for sediment loads entering the estuary, channel siltation and the need for dredging, though in practice we are unaware of it being a major issue. Much work is being done by other bodies on sediment movement in the Tamar Estuary.

Results of NRA invertebrate sampling show consistently high quality (see map 20 and Appendix D).

Source

River bank erosion and surface runoff from fields naturally delivers sediment to the river. An NRA study on the River Deer concluded that most suspended solids come from river bank erosion, rather than runoff from fields. It is also considered that cattle access (widespread throughout the catchment) is significant in generating suspended solids. There may be scope to further investigate sources, for instance, more detailed surveys of erosional processes and tracing experiments would be required to identify actual loading of sediment from different sources.

Elsewhere it is not clear from monitoring if suspended sediment loads are increasing or decreasing. Sampling programmes would need to be more detailed to detect real trends.

TARGETS & STATE OF THE CATCHMENT

Options

Options to address high levels of suspended solids would be dependant on identifying sources. If, as is generally believed, the bulk of the material comes from bank erosion in high flows two main options are available: reduce spate flows and protect banks. Each may involve a range of other options such as increasing wetland areas, creating buffer strips, reducing the effectiveness of land drains, fencing to prevent cattle poaching (trampling) and planting or reinforcing unstable banks.

As part of the River Deer project (see 5.3) the NRA has undertaken significant amounts of planting alongside watercourses to try and stabilize the river bank. It is too early to fully gauge the benefits of this project, which offers an opportunity to monitor rates of bank erosion along this planted length against a controlled section to gauge effectiveness.

The NRA has also produced a booklet on "Understanding Bank Erosion"²⁸ which looks at the subject from a conservation perspective, suggesting 'greener' options for control.

Issue 5: High levels of suspended solids in the Tamar Catchment.

Acidification

The headwaters of the River Lyd (A386 Roadbridge at Lydford) is affected by acidic runoff from Dartmoor, considered to be caused by natural causes (see 5.1). This area has been identified as a critical load area for forestry (see 4.4), where the NRA must be assured that any new forestry plantings will not reduce the pH.

During the first spate after a period of drought increased acidity and metal levels in the headwaters of the River Ottery and the River Kensey has resulted in fish kills (see 4.2). An investigation⁵ identified the problem to be a natural one; lowered water tables in the drought conditions allowing bacterial oxidation of sulphides naturally present in iron pyrites in the soil. These sulphides, along with metals such as iron and manganese can remain in the soil or precipitate on the surface. After the first rain they dissolve in the rising water table or surface water runoff to form acids, which then enter the surface watercourses, lowering pH and increasing metals levels.

Although primarily due to local geology, investigation into similar events on the Brightly Stream in the Devon Area highlighted that impact can be caused by relatively small areas and exaggerated by land drainage. This may also be the case in the Ottery and Kensey. There are also mines situated in the headwaters of both.

Following a mitigation exercise on the Brightly Stream there appear to be a number of measures which could be taken to reduce the impact. Such measures could include the control of metal leaching, reducing microbial action or artificially maintaining pH through liming in the first rains after a drought. However before any work can be undertaken, a more detailed study would be required to decide the most appropriate action, or combination of actions. In the meantime, the NRA will hold a watching brief at the end of a drought period.

Issue 6: Acidic runoff.

Consent assessment failures

As reported in section 4.12 there were a number of dischargers which failed consent assessment in 1994. It is part of standard NRA practice to encourage and work with dischargers to identify the causes of failure and make improvements to prevent a re-occurrence.

TARGETS & STATE OF THE CATCHMENT

Of the 1994 failures investigations have identified the following categories:

- * Works with suitable infrastructure but management needed improving: 7 (Stoke Climsland, Pyworthy, Holsworthy, Sourton Down STW's, Endsleigh Hatchery, Inny Vale Holiday Village and Dairy Crest Creamery).
- * Inappropriate consent: 1 (Pipers Pool STW). This has been reviewed and re - written.
- * Cause not definitely identified: 2 (Blackhill Quarry, Millaton Nursing Home).

Action has been taken by all dischargers in the first 2 categories to comply with consent.

All discharges will continue to be monitored and appropriate action taken to enforce consents.

TARGETS & STATE OF THE CATCHMENT

5.2 Water Quantity Targets and Current State

5.2.1 Water Resources Strategy & Policy

The NRA has a duty under the 1991 Water Resources Act to conserve, redistribute, augment and secure the proper use of water resources in England & Wales. In fulfilling this role the NRA must also carry out its general duties of environmental conservation and have regard to the statutory obligations of water companies.

NRA Policies

The NRA has recently published the Regional Water Resources Development Strategy "Tomorrow's Water"²⁴. This strategy sets out the approach the NRA will adopt when faced with a resource development proposal. The key NRA policies are to:

- plan for the sustainable development of water resources, developing criteria to assess the reasonable needs of abstractors and the environment
- plan the future use of water on the basis that water supply companies reduce leakage to an acceptable level and make best use of available resources
- investigate and where possible ameliorate inherited river low flow problems caused by licensed abstraction
- encourage the introduction of selective domestic metering, with appropriate tariffs, by water companies where resources are under stress
- promote the efficient use of water by industry, agriculture and domestic users.

Effective catchment management planning is crucial to the success of the strategy to ensure that any new developments are sustainable and do not damage the water environment. Planning at catchment level will enable the NRA to identify more precisely the spatial distribution of resource and demand. This will highlight areas where there could be the potential for sustainable development and help avoid unnecessary consideration of schemes in catchments lacking any such potential.

5.2.2 Current & future demand for water

As part of the work to develop the Regional Water Resources Development Strategy, the NRA has examined the current level of public water supply resource development and private resource commitment. The current level of available developed resource has then been compared with the NRA's forecasts of future demand for water. From this comparison it is possible to identify areas of potential surplus and deficit through to the year 2021 (the end of the current planning horizon).

Public Water Supply - Water Companies

The extent to which demand for potable water supply will increase over the next 30 years will depend upon a number of factors including population growth, numbers of new dwellings, personal use of water, level of economic activity, measures to reduce demand and climate change.

TARGETS & STATE OF THE CATCHMENT

For the Regional Water Resources Development Strategy, the NRA has produced demand forecasts for the area served by SWWSL's Roadford Strategic Supply Zone, which includes most of the Tamar Catchment as well as areas of North Devon and the South Hams (see section 4.11 for a description of the Roadford Strategic Supply System).

Resource-Demand Balance

The Roadford Strategic Supply Zone has a reliable yield of 326 Ml/day (see section 4.11). Comparing this to the current (1992) demand (246 Ml/day) shows that there is currently a surplus of 80 Ml/day. This is because Roadford Reservoir has been designed to meet demand in the early 21st century.

Clearly, with a large resource surplus there is no need for any immediate additional resource development for public water supply.

For future demand, alternative scenarios are presented in the form of a "high" and a "low" forecast. The "high" assumes high growth in all consumption, no improvements to reduce losses and no increase in domestic metering to reduce water use. The "low" assumes low growth in domestic consumption, no growth in industrial/commercial consumption, broad company leakage targets for SWWSL of 200 litres/property/day and no increase in the proportion of domestic properties subject to metering above 1991 levels.

The demand forecasts for 2021 for SWWSL Roadford Strategic Supply Zone are:

Table 16: Future demand forecasts for SWWSL Roadford Strategic Supply Zone

Forecast Future Demand (Ml/year)			
	2001	2011	2021
High Scenario	272	308	347
Low Scenario	243	265	291

Comparing these forecasts to the current reliable yield of 326 Ml/day shows that in 2021 under the high scenario there will be a deficit of 21 Ml/day but that under the low scenario there will be a surplus of 35 Ml/d.

Future Options - Demand Management, Resource Management & Resource Development

Under the NRA policy of encouraging demand management and leakage control (the "low" scenario) there will be no need for any major new sources in the Roadford Supply Zone (and hence the Tamar Catchment) until after 2021.

However, if demand does rise in accordance with the "high" scenario there will be a resource deficit in 2021. The NRA must have regard for the statutory obligations of water supply companies to provide a reliable supply of potable water to their customers.

TARGETS & STATE OF THE CATCHMENT

In line with NRA Water Resources Policy, we would consider options in the following order of preference: demand management, resource management and resource development. Further detailed information on these options can be found in the Regional Water Resources Development Strategy²⁴.

Specific options which would affect the Tamar catchment and how its water is used have been identified. They are:

Resource Management - Roadford Operational Management Strategy (ROMS).

The NRA has a duty to secure the best use of developed resources whilst conserving and where possible enhancing the environment. Therefore we are currently undertaking a project which aims to devise a detailed Operational Management Strategy for the Roadford Strategic Supply System.

The aim is to optimize the conjunctive use of the various water resources which make up the system, whilst taking into account environmental considerations. The project involves the construction of a computer model of the Roadford system coupled with environmental investigations and monitoring. The co-operation and involvement of the undertaker, SWWSL, will be essential to the successful development and implementation of a Roadford OMS.

Resource Management - Additional Links Between Roadford, Colliford & Wimbleball Strategic Supply Zones.

This would involve improvements to the mains distribution system to increase the inter-connection between the three Strategic Supply Zones. This would enable resources to be managed more effectively, moving treated water from areas where there is surplus to areas of deficit.

However, large scale imports from the Colliford Zone under the "high" scenario are unlikely to happen because this Zone would have insufficient resources to meet its own demands in such a situation (see Seaton, Looe and Fowey Catchment Management Plan²⁹). Imports from the Wimbleball Zone may be possible but this has yet to be investigated.

Resource Development - Roadford Pumped Storage.

The pumping of water to Roadford Reservoir from further downstream in the Tamar Catchment at times of high flows, i.e. winter, would provide an additional resource.

This would be attractive to the NRA because best use would be made of an existing reservoir and it would delay the need for a new reservoir development in the Tamar, or neighbouring catchments, beyond the planning horizon of 2021. The option has yet to be investigated in depth but initial estimates suggest an additional 50 Ml/day reliable source output could be obtained. This is a preliminary estimate, to be investigated further.

Effects On The Catchment

At this stage it is too early to make a complete assessment of the effects upon the Tamar Catchment, which is one of several affected by the Roadford scheme, through any developments/changes to its operation. However, the NRA are ensuring that a plan is in place to allow a complete assessment by the year 2002.

TARGETS & STATE OF THE CATCHMENT

The modelling and environmental investigations work currently being carried out will clarify the current and likely future operation of the sources located in the Tamar Catchment. In particular, the work will determine the environmental requirements for the system's operation and the future demands that will be placed upon the key sources of Roadford Reservoir and the River Tamar at Gunnislake.

Issue 7: a. Operational management and development of Roadford Reservoir Water within the Roadford Strategic Supply System.

b. The impact of Roadford reservoir on the Tamar Catchment.

Private Water Supply - Other Abstractors

Growth in private supplies tends to be dispersed across the catchment, in contrast to the more concentrated point sources for public water supply.

Each application will be assessed on its merits. The NRA aim to promote growth but have to determine abstraction licence applications with effect to the impact on the environment.

Predictions of future growth in demand for private water supply are more difficult to assess than those for public water supply. Water use is greatly influenced by numerous and differing political, economic and environmental factors and any predictions are always likely to be subject to the unpredictable influences of commercial markets.

Nevertheless, the NRA's Regional Water Resources Development Strategy adopts the following national predictions for future growth in private demand:

Growth Rate/Year

Spray Irrigation 1.7% (1995 to 2001), 1% (2002 to 2021)

Industry 0.75%

All Other Uses 0%

Applying these rates to the nett resource commitment (see section 4.11), it is predicted that annual private demand in the Tamar Catchment will increase by 120 Ml in 2021. This growth is entirely due to the anticipated increase in spray irrigation and industrial/commercial use which are given in Table 17.

Table 17: Forecast growth in private demand for the Tamar Catchment (using National predicted growth rates)

Abstraction Purpose	1995 Nett Resource Commitment (Ml/year) ¹	FORECAST FUTURE DEMAND (Ml/year)		
		2001	2011	2021
Spray Irrigation	1.9	2.1	2.3	2.6
Industry	558.7	584.3	629.7	678.5

Note: 1. See section 4.11

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However, it should be borne in mind that these predicted growth rates are from national studies and that growth in water use for industry or spray irrigation in the Tamar Catchment is unlikely to be as high as the figures in Table 17 suggest.

Industry.

In particular, the national predicted growth rate for industrial water use may be excessive given that:

- industrial growth is likely to be limited bearing in mind that in recent years, due to recession and changes in the economy, there has been a marked decline in the uptake of private licensed resources for industrial use
- abstraction of water is not a necessary adjunct to industrial growth.

Therefore, in reality future growth in industrial water use in the Tamar Catchment will probably be limited and could largely be met by the increased uptake of existing licensed resources.

Spray Irrigation.

The anticipated growth in demand attributable to spray irrigation represents an increase in annual resource commitment of 0.7 MI by 2021. However, there are no indications that there will be major growth in spray irrigation in the Tamar Catchment and so it is likely to be less than that predicted using the national growth rate.

There may be some growth in agricultural abstraction as farmers seek a cheaper alternative to the cost of mains water supply. However, this is unlikely to be significant.

Hydropower.

As seen on Table 10 (p68) hydropower has the largest authorized quantity of water for private use. Two licences make up the majority of this total, though only one (Trecarrell Mill) is known to be producing electricity. Both are Licences of Entitlement, one of which was identified as a potential low flow site (see below). Additionally there is a hydropower generation plant at Roadford Reservoir operated as part of the supply scheme.

Hydropower is not considered to be a water use likely to grow significantly, in terms of power production within the catchment. A report for South West Electricity Board (SWEB)⁴⁴ identified only two potential sites for hydropower generation within the catchment, both of which were considered by the NRA to have major constraints and the report noted that many of the sites identified within the SWEB region "may be unsuitable on grounds of high development costs or environmental considerations.

In summary, the NRA does not consider growth in private water demand to be a major issue for the Tamar Catchment.

5.2.3 Low flows & the water environment

The needs of the environment require sufficient water of suitable quality in rivers, lakes and aquifers. Low flows and water levels can have unacceptable impacts on water quality, aquatic animals and plants, wetlands, landscape, recreation and amenity as well as archaeology and cultural heritage.

The requirements both of plants and animals are not easily defined due to the large diversity of species and the complexities of their response to changes in water availability.

TARGETS & STATE OF THE CATCHMENT

Knowledge of the needs of catchment wildlife is not precise enough at present to identify and set targets for flow requirements. Similarly the general flow requirements of different ecosystems and particular species (excepting fish) is not known. The NRA is currently engaged in a National NRA project on minimum acceptable flows to establish flow requirements.

Issue 8: Lack of knowledge of wildlife flow requirements.

Low Flow Sites

In 1990 NRA South West Region commissioned a report identifying the problems caused by artificially low river flows within the region. This report "NRA South West Region - Low Flows Study"³⁰ identified 109 low flow sites in Devon and Cornwall where low flows could adversely affect the river in terms of amenity, fisheries or ecology. These sites were ranked as "serious, major, medium, small, or minor" according to the perceived severity of impact.

Overall, the Tamar catchment is not stressed by abstraction. Of the four sites identified within the catchment only one, Lower Tamar Lake, was considered as 'major' in a regional context. The others, Trecarrell Mill, Woodley Stream and downstream of the Gunnislake abstraction were either classified as "small" or "minor". The NRA has planned no investigations of these 3 sites, but the downstream conditions at Gunnislake will be studied within the ongoing Roadford Reservoir investigations.

Lower Tamar Lake: Low Flows downstream of lake

The NRA is concerned that at times of low flow there has been a severely depleted or dry stretch of river immediately downstream of Lower Tamar Lake which has reduced the habitat available to juvenile salmonids.

In 1991 SWWSL made a formal application to temporarily increase their abstraction from Upper Tamar Lake. The NRA issued a revised licence in 1992. The licence is in two parts; Part A containing conditions in force until 31st December 1994 and Part B containing conditions in force from 1st January 1995.

During the period until 31st December 1994 SWWSL were required to make compensation releases from both Upper and Lower Tamar Lake. The original licence had only required a compensation release from Upper Tamar Lake. SWWSL were also required to provide and install the necessary equipment to continuously measure the compensation releases from both lakes.

A new weir structure has now been constructed downstream of Lower Tamar Lake and new flow monitoring equipment installed there as well as below Upper Tamar Lake.

On 1st January 1995 the abstraction quantities reverted to those on the original licence and SWWSL were no longer required to make compensation release from Lower Tamar Lake although they still had to make releases from Upper Tamar Lake at all times.

The input to Lower Tamar Lake is made up of the compensation release from Upper Tamar Lake and flow from two small tributary streams. One drains into the short stretch of stream between the two lakes whilst the other drains directly into the lower lake itself. As there is no abstraction from Lower Tamar Lake there should be sufficient inflow to guarantee a compensation flow at least equivalent to the compensation flow from Upper Tamar Lake.

TARGETS & STATE OF THE CATCHMENT

Improvements to the measurement and monitoring of compensation releases described above should lead to improved flow conditions downstream of Lower Tamar Lake. However, the NRA is continuing to monitor juvenile salmon production to see whether or not these changes have had a beneficial impact. It will also seek assurances from SWWSL that any changes to the level of Lower Tamar Lake do not adversely effect flows downstream of the lake (see Issue 10).

Issue 9: Low flows downstream of Lower Tamar Lake

Lower Tamar Lake: Management Of Water Levels

SWWSL have been advised by the Reservoir Inspection Panel Engineer that, in order to meet revised legislative requirements, remedial actions must be taken at Lower Tamar Lake dam. As one of two options, the water company have proposed lowering the level of the lake by 2 metres reducing the area of water from 20.5 to 4 hectares. The volume of the lake would then be less than 25MI, taking the dam out of the Reservoirs Act 1975 and reducing the maintenance requirements. Lower Tamar Lake is not used for public water supply but it is a recreation and conservation resource.

The NRA has serious concerns over the SWWSL proposals to lower lake levels and as a statutory consultee we have requested that a full Environmental Assessment is carried out , for which the NRA provided Terms of Reference. Although impacts on the lake could be considerable, opportunities for conservation enhancements, especially bird habitats and wetland creation, could arise from such a change.

At the time of writing the NRA have just received the Environmental Assessment and will examine it in depth.

Issue 10: Management of Lower Tamar Lake water levels

The NRA will be producing water level management plans on two sites within the catchment, (see 5.4).

TARGETS & STATE OF THE CATCHMENT

5.3 Physical Features

Landscape

Around 30% of the catchment is covered by landscape designations in recognition of its high landscape value. Additionally there are two new areas proposed:

- Tamar Valley as an AONB
- Three sections on the Cornish side of the Tamar Valley between Stoke Climsland and North Tamarton as an AGLV.

Landscape Character

The Countryside Commission has defined the landscape types within 'The New Map of England'³¹. Most of the catchment is within the 'Holsworthy Culm Belt' landscape typified by rolling hills and farmland with small fields, scattered and remote farmsteads and hamlets, damp pastures, rushy fields, flower-rich hedges, wooded valleys and coniferous woods on the slopes.

An intricate network of fast flowing streams and rivers dissect the hills, creating shallow valleys. Agriculture, predominantly dairying, is the major land use here, but is often on the margins of viability. Much of this area is also included in the recent draft report 'The Torridge Landscape'³². This report raises management issues and recommendations for action. Some of these issues and options are directly related to the water environment and involve the NRA.

Part of the 'Tamar Valley' landscape area extends over 15% of the southern catchment. It is characterized by deep, wooded valleys with steep slopes, high ridges, mining remains, bridges and meandering rivers. Dairying, mixed farming and forestry are common land uses, but formerly flourishing market gardening and metalliferous mining have left their mark on the landscape. This area contrasts strongly with the rolling Culm region to the north, and the exposed moorlands of Bodmin Moor to the west and Dartmoor to the east, which constitute the remainder of the landscape within the catchment.

A discussion document 'Taking the Tamar valley towards 2000' has been produced⁴ highlighting landscape characteristics, threats, issues and actions. Some of these issues, related to the water environment, involve the NRA.

Two significant recent additions to the landscape of the area are Roadford Reservoir and the A30 Lifton/Lewdown bypass.

Semi-natural habitats within the catchment

On the Cornish side of the catchment semi-natural habitats make up approximately 15% of total land area of which habitats within the water environment can be identified (see Table 18).

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Table 18: Land Use Areas - Natural and Semi-natural Habitats

CATEGORY	Area (Hectares)	% of Total Area
Broadleaved Woodland	2827.54	5.0
Unimproved Grassland	2094.13	3.7
Possibly Unimproved Grassland	1555.47	2.8
Conifers	811.20	1.4
Wetland	457.10	0.8
Scrub	277.04	0.5
Bracken	160.67	0.3
Heathland	153.16	0.3
Open Water	119.45	0.2
Total area of Semi-Natural Habitat	8455.75	15.0
Total Area of Upper Tamar (Cornwall)	56212.41	100.0

Source: CWT (LIFE Project)

The NRA can have direct influence over two major habitat elements:

i) Riparian Zone

Across the catchment fragments of semi-natural habitat are linked by thick hedgrows, typical of the district, and by belts of trees along the banks of streams and rivers. This latter riparian (riverside) vegetation is made up of species such as oak, alder, sycamore, hazel and ash and supports numerous species, including otters. It plays an important role in the ecology of the river maintaining bank shape and stability, regulating temperature and providing food and habitat for many species.

The removal of bankside trees can lead to the destabilisation of river banks. The banks dry and shrink in summer and are washed into the river during a spate. Bank erosion seems to contribute significantly to the suspended solids loads in the catchment, (see 5.1).

The riparian vegetation also plays a valuable role in water quality through "buffering", slowing down surface runoff and enabling biological processes to operate properly. The removal of bankside trees also removes food and cover for fish and other water life.

To maintain the integrity of the river and riparian zone as an important wildlife corridor the NRA will normally seek to resist new 'hard' development in a 7 metre buffer zone and to enhance the ecological value of this area where possible. We also look to use and support initiatives such as the Countryside Stewardship Scheme and work with organisations like English Nature and the County Wildlife Trusts.

TARGETS & STATE OF THE CATCHMENT

The riparian zone throughout much of the catchment is largely undeveloped. However, through changes in land use areas of natural and semi-natural habitat have been reduced or degraded. Little work has been done on assessing the loss of such riparian habitat, and so the setting of targets to restore the losses is not currently possible. There are currently 3 methods of survey which are in use or being developed which may overcome this lack of knowledge:

Aerial photography

Surveys of broad categories of habitat within the Cornish side of the catchment have been undertaken through the interpretation of aerial photographs. This could be compared against previous data to monitor general rates of habitat change, as well as particular areas of loss, or gain. This information can also be put into a County context to prioritize areas for action. This work is being led by the Cornwall Wildlife Trust. To date a similar database does not exist for the Devon side, however the NRA does possess one set of aerial photographs which it is having analysed. A further set would be required for useful comparison to take place.

River Corridor Surveys

For the purposes of site specific assessment more detailed information is required. The NRA has a limited amount of River Corridor Survey (RCS) information, based on sites where we are involved in maintenance, projects, or which we own. Resources do not allow for extensive RCS throughout the catchment, or to adequately manipulate the data once gathered.

River Habitat Survey

The NRA is developing a new River Habitat Survey (RHS) methodology which assesses a number of physical and biological features on a given river section. This can then be compared to an expected "normal" for that type of river stretch. This systematic appraisal of watercourses should identify sections failing to meet their ecological potential and enable objective targets to be set. It could be the intermediate methodology required to link the habitat data and RCS.

Issue 11: Protection and enhancement of riparian strip.

ii) Culm grassland and other wetlands

English Nature is developing a system of 'Natural Areas' descriptions for England. The carboniferous Culm Measures have greatly influenced the northern 75% of the Freshwater Tamar catchment, giving rise to a distinct ecological type known as the 'Culm Measures Natural Area'.

Apart from the important communities and species they support, an important natural function of Culm is as a filter. In the headwaters and upper catchment natural buffering can slow the rate of surface water runoff delaying water release to the water courses. This also encourages suspended solids to settle out of suspension, preventing water quality problems.

One quarter of all SSSI Culm grassland is found within the catchment. Between 1984 - 1989/90, 61% of Culm grassland was lost, primarily through agricultural improvement, largely due to agricultural land drainage. Most remaining sites, however, are very small and are vulnerable to deterioration either through agricultural intensification or agricultural neglect. Measures are being undertaken by English Nature, Devon and Cornwall Wildlife Trusts, the Ministry of Agriculture Fisheries and Food and Local Authorities to assess the remaining resource and plan for its conservation. This should generate targets and action points for all the agencies and individuals involved to progress the conservation of Culm grassland. Currently, of 605 hectares of Culm grassland within the Devon parts of the Tamar Catchment, 245.54 ha are protected under various conservation schemes. Protection also exists on the Cornish side though figures are not available.

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Although the remaining area of Culm grasslands has been recently assessed (1994), areas likely to be suitable for the re-establishment of this habitat have not been thoroughly researched, and existing Culm that could be enhanced has yet to be identified. This would require a staged project, highlighting potential sites through desk top studies, field visits and liaison with landowners and potential granting bodies.

Devon Wildlife Trust have concerns over the loss of floodplain wetlands and the lack of a strategic approach to floodplain wetland restoration. They are currently working on a 'Wildlife Strategy for Devon's Rivers and Wetlands'⁴⁵ which will set biodiversity targets for habitats and species identified as being of key importance to the aquatic environment of Devon. The NRA is a partner in the strategy and will adopt appropriate recommendations. A possible area target would be from the Kensey/Tamar confluence downstream to Greystone Bridge.

Issue 12: Develop the protection of existing wetlands, especially Culm grassland, and actively seek opportunities to recreate wetland habitats through strategic planning with other bodies.

Forestry

Contributing to the identified habitat loss is the change in agricultural land use and the loss of ancient semi-natural woodland which has been replanted with conifers, which are generally recognized as having reduced conservation value. National R&D shows that mixed age structure reduces the environmental impacts of forestry. The latter option will however incur a cost if blocks are cut before or after their financially optimum time. Areas of conifers are due to be felled, and re-planting provides an opportunity to introduce a mixture of species and vary the ages of the stands.

Within Forest Enterprise woodlands the riparian zone will be replanted with broadleaf trees, with particular consideration for conservation, recreation and landscape interests. This is in line with the Forest and Water Guidelines⁹, (see Section 4.4). Generally the NRA looks to input into forestry plans when the Forestry Authority and planning authorities are granting planting licences.

Acidification

As discussed in Section 4.4 only a small part of the catchment falls within an identified Critical Load area. However the headwaters of the catchment outside this area are acidic and the NRA would have concerns about any new large plantings in these areas further lowering pH. This would be particularly so in the Ottery and Kensey where fish kills already occur, see (4.2). The NRA will continue to liaise with the Forestry Authority to prevent any such impact.

Short rotation coppice

The development of short rotation coppice of species such as hazel is a potential growth area providing material for electricity generation and chipboard manufacture. Within the catchment the proposed production of Biomass energy in the Torridge district has implications for landscape and for wildlife. Increased deciduous woodland cover is generally desirable but there are concerns about such plans impacting on the floodplain and water environment through possible loss of flood storage area and valuable habitat, particularly wet grassland. The NRA will be keeping a watching brief on the development of any proposals and land changes through liaison with MAFF, the Forestry Authority and planning authorities.

TARGETS & STATE OF THE CATCHMENT

Species Protection

The Salmonid fishery

Target: Optimizing the size of the natural Salmonid fishery to fulfil its environmental capacity

An exact target for the maximum carrying capacity for salmonids has not yet been established. However the NRA is currently involved in implementing a classification scheme following a research and development project. This will enable the NRA to set targets for the Tamar Catchment and also to put the Tamar fishery in a National context. The results of this work should be available prior to the publication of the action plan. Our fish counter at Gunnislake will allow us to monitor and review these targets.

Despite not having the classification scheme in place the natural fishery of the Tamar Catchment is considered as being of very high quality, as shown in various surveys (section 4.2 and Appendix B). The juvenile salmonid fishery is particularly good in the Rivers Ottery, Lyd and Inny. Although there are many productive areas within the Tamar catchment, there is still potential for improvement, particularly in the Upper Tamar area. Juvenile salmon densities have been consistently poor and there is little indication of significant trout spawning in the Upper Tamar region. The smaller Upper Tamar tributaries are rarely used by salmon and no juveniles have ever been recorded on the Derrill Water, Small Brook and Tala Water.

Within these areas major constraints are thought to be:

Poor water quality

This is noted on some rivers due to: persistent pollutant inputs, i.e. agricultural land runoff or mining, or individual pollution incidents. These issues have been looked at fully in section 5.1.

Lack of spawning gravels

At various locations on the Tamar system there is an identified formation of a solidified channel bottom, known as concreted gravels. This is a particular problem when it occurs in areas where salmon would normally spawn as they are unable to do so as the gravels are too hard for them to bury their eggs.

A brief study of the formation, known locally as "Black Ram", show it to be a conglomeration of gravels cemented together by manganese and iron oxides. It is naturally formed and is uncovered by the eroding watercourse. The thickness can vary and can reach 2 feet. At such thicknesses it becomes difficult for the watercourse to cut through the formation and so work might be considered to artificially break it if we want to establish spawning areas.

The NRA has carried out such work at suitable locations in the catchment using a hydraulic excavator or a high pressure water lance to break up the solid formations and produce gravel beds which are suitable for spawning. Disturbance causes a release of suspended solids and discoloration of the watercourse. On site monitoring by NRA pollution officers shows this to be short lived and of no major consequence. Biological monitoring was undertaken before and after the work and data show that the number of invertebrate families increased as a result of the works, due to improved substrate. Annual redd counting has shown that salmonids have indeed spawned on the treated gravels.

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There may be processes equivalent to that forming the "black ram" occurring in watercourses. It is noted that hard manganese / iron coatings were occurring on natural gravels within the channel and that in instances these were bridging from one stone to another and bonding together. It is not known to what extent these formations exist, nor how much they may hinder redd formation.

Given that the major formation of "black ram" is in place and not a result of instream processes, breaking it up should only be required as a "one-off" operation. It might therefore be considered worthwhile for further work throughout the catchment.

In other areas gravels are being washed out of an area quicker than they are being replaced (recruited) from upstream sources, or there may be no upstream replacement, for example below impoundments.

Access

Access to spawning areas may be limited by major physical obstructions, largely trash dams (dams forming from wood and other natural debris). The NRA seeks to remove significant blockages which may impede the passage of migratory fish and can also cause a localized change in the flow regime resulting in impoundment of water and possible siltation of gravels upstream of the blockage.

However, overhanging trees and smaller blockages are a natural part of the river system. They provide substrate, food and shelter for in-stream organisms and may scour out pools and possibly rejuvenate gravels downstream. The importance of these effects on all river life is recognized by the NRA. We are developing an internal code of "best practice" on where and how to clear trash dams.

A new fisheries survey site on the Caudworthy Water at South Wheatley revealed a good salmon fry density in an area made more accessible by river clearance work in 1992. Trash dams on the River Inny were cleared in 1994 and also on the Lana Lake which may have been impeding salmonid migration. Trash dams are a recognized problem, limiting access to spawning areas on the River Thrushel, River Wolf and River Lew. Tributaries that would also benefit from trash dam clearance are Derril Water, Small Brook, Tala Water and the Portondown Stream.

Issue 13: Removal of blocking trash dams and trimming of overhanging trees preventing passage of fish or impacting spawning gravels.

Habitat

The removal of bankside trees and shrubs providing cover and habitat for adult and juvenile fish and increasing the rate of bank erosion.

See Issue 11.

River Flows

The impact of low flows from the operation of Tamar Lakes has been identified by the NRA as a limiting factor to salmonid production in the Upper Tamar area (see 5.2.3). The continuation of the ongoing Upper Tamar ALF studies (see Section 5.2); and/or, the results of the current environmental assessment by SWWSL (see Section 5.2) will give an indication of remedial action needed and where effort is best spent in rehabilitation.

See Issue 8.

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Upper Tamar and Tributaries Environmental Improvements Project (1989-1995)

This major NRA project was initiated to try and address some of the issues outlined above. On the Upper Tamar, River Claw and River Deer the work has consisted of:

- Areas of concreted gravels upstream of Launceston were dug in 1991, 1992 and 1994 (47 riffle areas on the Upper Tamar and 3.7 kms on the River Deer in total).
- To enable access for spawning adults to nursery areas trash dam removal work was carried out between 1990 and 1994.
- Gravel arrester weirs were constructed to minimize the downstream movement of spawning gravels to form enhanced spawning beds.
- Artificial spawning beds have been constructed using imported gravels. Eight have been constructed within the Upper Tamar area.
- Installation of croys and boulders in conjunction with gravel digging was carried out in areas of concreted gravels in an attempt to accelerate and concentrate flows to reduce silting and re-concretion of the substrate.
- Spawning gravels displaced by flooding and erosion were replaced in the North Tamerton area.
- To assist in erosion control 4,160 bankside trees have been planted on the River Deer, and boulders placed at strategic points.

Elsewhere in the Tamar Catchment the work has consisted of:

- Gravel replacement on the lower Penpont Water and Upper River Lyd.
- Artificial spawning beds on the River Thrushel, River Inny and Penpont Water.
- Gravel arrester weirs on the River Lyd.
- Extensive trash dam clearance on the Rivers Carey, Wolf and Thrushel.

Initial surveys to assess the effectiveness of the work have to date been limited and results have been inconclusive. It is planned to carry out further survey work to fully establish the benefits of the work.

Issue 14: Assessment of the natural fishery to confirm benefits of improvement works.

Particular Stock Components

Multi Sea Winter Salmon : Since the early 1970s the proportion of grilse to two sea winter salmon (2SW) has altered and there is currently a much higher proportion of grilse in the population. Within this component there has been noted a significant decline in returning numbers of spring salmon on the Tamar which reflects a regional trend. It is most likely that factors at sea are largely responsible for this decrease, however they have reached levels where the NRA feels it necessary to consider action. The NRA South Western will assist in promoting a National investigation into the decline of multi-sea winter salmon and will consider possible measures to increase escapement.

Issue 15: Decline in catch of multi sea winter salmon (including spring salmon).

Sea Trout : Catches of sea trout can vary widely from year to year and recently catches have been below the long term average. This trend is reflected in records from other UK rivers. The NRA South Western will assist in promoting a National NRA investigation into the decline in sea trout stocks.

Issue 16 : Decline in sea trout catch.

Illegal exploitation of salmonids and rod licence evasion

Sporadic poaching takes place in some productive areas of the Tamar Catchment.

In addition rod licence evasion is still a problem, particularly with visiting anglers who may not

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be aware of the need for a NRA rod licence. The NRA will continue rigorous and high profile enforcement on rivers and through greater publicity of the NRA and the legal requirement to buy a rod licence will increase licence sales.

Issue 17: Illegal Exploitation of salmonids.

Natural predation

Natural predation by mammals and birds occurs throughout the fishery. At present it is not known if this is causing a significant impact on fish stocks. The NRA works with fisheries owners and MAFF to advise on preventative measures. Licences to kill predators are issued by MAFF. The NRA will not support the licensed killing of predators until and unless proof of serious damage has been established and killing proven to be the most effective means for preventing significant loss to fish stocks.

The NRA will co-operate with the licensing authority to progress further research into this issue and continue to work positively with owners and anglers to establish the full facts in each case.

Introduced and escaped fish

There are numerous still-water lakes throughout the catchment stocked with non-native fish species. Various species have been found in fisheries surveys, almost certainly escapees are from private/public fisheries and ponds (see Section 4.2.). The NRA has concerns that these may compete with and introduce disease to the native fishery.

Issue 18: Introduction of non-native fish species.

Loss of natural Channel

The construction of Roadford Reservoir has denied salmon and trout access to approximately 35% of its original length. The wetted area has been reduced by 50%. Mitigation Programmes continue, incorporating a stocking programme as well as the Enhanced Flow Programme.

Siltation of gravels is considered to have caused a decline in the Wolf trout population and salmon redds below Roadford Reservoir seem unproductive, possibly due to siltation. Roadford Reservoir regulates river flows and releases are generally of clean water (low suspended solids). The Enhanced Flow Programme includes winter releases to aid flushing the gravels of silt but further releases may be required. SWWSL are working with the NRA and others to achieve increased wild salmonids. Catchment protection of the Wolf Valley may be required to manage suspended solids loads.

The continuation of the Roadford environmental monitoring and investigations work (with an extensive electric fishing survey in 1995 on the River Wolf) will enable the NRA to monitor the situation and consider alleviation measures.

Issue 19: Poor salmonid recruitment on the River Wolf.

Obstructions to fish passage

Work has been carried out on removing obstacles to fish migration over the past few years. Juvenile fish surveys have shown that this has been a success. Migration past Ashmill Weir on the River Carey was assisted by installation of a Baulk fish pass in October 1992. At the same time a Modular Denil fish pass was constructed on the River Lew near Bridestowe to aid upstream salmonid migration. Juvenile salmon have since been found upstream of the fish passes. Improvements to Virginstow Ford over the River Carey which may obstruct the free passage of fish should be investigated.

Issue 20: Virginstow Ford on River Carey perceived as obstacle to fish.

Figure 1



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Roadford Reservoir

The prescribed flow at Gunnislake is due to be reviewed in 2002, based on the current programme of investigation and monitoring work.

See Issue 8.

Poor salmonid juvenile densities have been recorded on the River Claw, upper Henford Water, Luckett Stream and the Ogbeare Stream. Luckett Stream has elevated metal levels, especially copper, which might prevent salmonids, however the Portondown stream experiences similar copper levels but has a very healthy trout population. Reasons for poor densities on the other watercourses is also not definitely known and should be investigated with a view to implementing alleviation measures.

Issue 21: Poor salmonid juvenile densities on the River Claw, upper Henford Water, Luckett Stream and the Ogbeare Stream.

Otters

The Otter (*lutra lutra*) is protected under EU legislation² and the Wildlife and Countryside Act (1981)³³. The largest population and greatest density of otters in England occurs in the Culm Measures Natural Area. This population has become particularly important as a stronghold from which otters can expand outward and there has been a notable expansion and increase in distribution in the 15 years since the national surveys began. A precautionary approach should therefore be maintained with this species, its habitats and food supply should be protected and enhanced throughout the catchment, even though the otter in the South West is considered a 'success story'.

Otters need a healthy food supply, abundant vegetative cover on river banks and a low level of human disturbance. The NRA can greatly assist this species through promoting measures such as improved water quality, sensitive river maintenance and controlling the degree of riverside development. This is carried out through the framework of the NRA National Otter Strategy⁴⁶.

The lack of regenerating bank side trees and other tall vegetation on many stretches of the main river and tributaries needs addressing, and replanting or fencing to help regeneration will be encouraged throughout the catchment - not just on NRA properties. Monitoring of both the species and its habitat, and dead otter post mortem and analysis for PCBs, heavy metals and other substances needs to continue.

Issue 22: Review status of otters in the catchment to ensure its needs are protected.

Freshwater Invertebrates

One significant indicator of the quality of the water environment is the freshwater invertebrate community and the food chain this supports.

The NRA carries out an invertebrate monitoring programme throughout the Tamar Catchment. The results of this work are used primarily for water quality assessment, however substrate (habitat) must be taken into account and they therefore also act as a wider biological indicator. One of the major features of biological monitoring is that, once the invertebrate community has been impacted by a pollutant, its effect can be recorded for many months after the event. Samples taken are sorted and the invertebrate families present are recorded. A score of 1 to 10 is allocated to each invertebrate family, or taxon, based on their sensitivity to pollution and a BMWP (Biological Monitoring Working Party) score is derived by adding up each taxon score for the sample. Additionally an ASPT (Average Score per Taxon) score can be calculated; this is

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the BMWP score divided by the number of scoring taxa and represents the 'average sensitivity'. To classify the quality of a site, both in a national context and in terms of what we would expect to find at a site if it was unpolluted, the River InVertebrate Prediction And Classification System (RIVPACS) is used. A computer programme is used to predict, from the physical and chemical characteristics of a site, the likely BMWP score assuming the site was unpolluted and undisturbed. This predicted score is then compared with the actual score recorded. The results of RIVPACS in the Tamar are given on Map 20 (page 108). More detailed site descriptions are given in Appendix D.

Biological (and fisheries) data generally indicate a high quality water environment, supporting varied invertebrates, game and coarse fish. Localized problems however, particularly metal contamination, have reduced the diversity and abundance of both groups.

Other rare and vulnerable species

The presence of locally, nationally and internationally important species within the catchment is an indication of its quality and diversity. Records indicate that populations of some species are holding ground and, indeed, in some cases, such as the otter, are increasing, but others are declining and warrant consolidated protection.

Bats

The catchment may be of national importance for some species of bat, particularly on the River Tamar for a few miles above the tidal limit. Bat roost sites are potentially vulnerable through works carried out in the river corridor.

Marsh Fritillary (*Eurodryas aurinia*).

This butterfly's national stronghold is on the Culm grasslands. Closely associated with the well-being of its food-plant, Devils Bit Scabious, the Marsh Fritillary is extremely sedentary in nature and as expansion by recolonisation is unlikely, the conservation of all remaining colonies is vital. The NRA would seek to prevent any remaining Culm grassland being lost. Several other uncommon butterflies and moths depend on the Culm, including Marbled White, Pearl-bordered Fritillary and Narrow-bordered Bee Hawkmoth. See Issue 12.

Curlew (*Numenius arquata*).

This wading bird needs poorly drained moorland and pasture to breed successfully. The Devon population is estimated to have declined by around 40% since 1968-72, but a number of pairs still breed on the wet grasslands of the catchment. The Curlew feeds upon soil invertebrates and it is critical that the soil remains moist enough during the spring and summer. Drying out soil through land drainage has a negative effect on these birds.

Snipe (*Gallinago gallinago*).

This wader has declined by about 60% in Devon since 1968-72, but remains in small numbers on the Culm. Its requirements, and threats, are similar to the Curlew. A further consequence of land drainage is that stock are able to graze earlier in the season and this leads to nest trampling. It is believed that the wintering Snipe population in the catchment is of national importance.

Kingfisher (*Alcedo atthis*).

A fish-eating river bird protected under EU legislation² and the Wildlife and Countryside Act (1981)³³. It currently breeds in a few places in the catchment and is dependent on high water quality which sustains its food supply, small fish, and the retention of suitable steep, soft riverbanks for nesting tunnels and overhanging vegetation for hunting perches.

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Sand Martin (*Riparia riparia*).

At least one colony of this summer visitor occurs in the catchment. Since 1968-72 the British Population has declined by about 24% and so the remaining colonies are of increasing importance. Sand Martins breed in tunnels in sandy cliff faces, the retention of which the NRA fully considers during river maintenance work.

Dipper (*Cinches cinchis*).

This bird is characteristic of the fast-flowing rivers in the catchment and breeds at a number of sites. A healthy population in particular is known on the River Inny. Feeding on aquatic invertebrates, Dippers are dependent on high water quality. The NRA can assist this species during bridge and riverbank repair work by inserting nest boxes.

Barn Owl (*Tyto alba*).

Culm grassland is a national stronghold for this species. The area is believed to hold 5% of the breeding population, which has declined across Britain by nearly 40% since 1968-72. Maintenance of rough grass for hunting and mature trees for nesting are vital, and the creation of artificial nesting sites can assist the owl.

Cryphaea lamyana

This moss is nationally rare (listed in the Red Data Book³⁵) and is found at a couple of locations on the River Tamar. It is a flood zone specialist (i.e. above the average water level) and grows on the trunks of mature bankside trees.

The NRA has an important role to play in the conservation of all aquatic and wetland species, not just those discussed above, through its water quality improvements, river maintenance and statutory consultation roles. Maintaining a natural river regime wherever possible is the basis behind much of the conservation of these species.

Indicator species such as dipper and kingfisher seem to exhibit healthy populations, however information is not comprehensive and cannot be related to specific numeric targets for populations. The NRA carries out various forms of survey, though only fisheries and invertebrate data is of a detailed nature. There is an identified need for more detailed wildlife information to tie in with other studies.

See Issues 8, 11, 12.

Invasive Species

Japanese Knotweed, Himalayan Balsam and Giant Hogweed occur in a number of places within the catchment. These species can cause problems, including:

- the shading out of native plant species and the prevention of natural regeneration of broadleaved trees;
- increased bank erosion as banks are left bare in Autumn;
- dense stands restrict access to rivers.

Under the Wildlife and Countryside Act 1981³³, it is an offence to plant or otherwise cause Japanese Knotweed and Giant Hogweed (which can be harmful to humans) to grow in the wild. Himalayan Balsam has yet to be included in this Act. Japanese Knotweed and Himalayan Balsam are present throughout the catchment, though their full extent is not known. Giant Hogweed is growing at Endsleigh Hatchery. Impacts on native species can be locally significant and work needs to be done to monitor both spread and impact.

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The problem has a fairly high public profile in some areas and requires action, by landowners and managers as well as the NRA. It is recognized that Japanese Knotweed is particularly suited to spreading along watercourses and can colonise areas quickly. It is a problem species found on many South West rivers and could involve considerable resources to try and undertake control. Therefore we would consider that effort should be targeted at locations where impact is both known and significant. Effective control is dependant on co-ordinated, catchment wide action. The NRA has produced a leaflet "Guidance for the control of invasive plants near watercourses"³⁴ and is continuing research into these invasive species.

Issue 23: Assess the extent and impact of invasive species.

Archaeology

There is rich and extensive archaeology within the catchment as seen in the range and number of designations, however there is a relative lack of general information on the resource.

Archaeological features are at risk from direct damage by NRA work e.g. river maintenance and dredging, and indirectly through the drying out of organic remains through lowered water tables and the deposition of spoil on sites. The current NRA archaeological database is not detailed enough to fully address the impact on rivers and wetland related archaeology of 'NRA vetted' proposals, especially the expected Water Level Management Plans.

The general lack of an adequate database detailing the archaeological resource throughout the catchment has been identified by other groups who are looking to promote schemes to address this failing.

Issue 24: Lack of detailed archaeological information.

Recreation

Public Access

There are long-term plans to develop recreational footpaths along the River Tamar and its tributaries. However this might conflict with other established interests. The catchment is of international importance for otters and national importance for mosses and lichens. Any increase in human activity may disturb the wildlife. There is a nationally recognized rod fishery and disturbance may impact on fishermen. Additionally, landowners may have varied reasons for not wanting access. However full consultation and the careful planning and siting of paths can minimize such conflicts.

Issue 25: The development of recreational path.

Water-contact Sports

Roadford Lake and Tamar Lakes are popular locations for sailing and other water-contact sports. Roadford is only five years old and this use is predicted to increase in the future.

Blue-green algae in summer conflicts with recreational use of the Tamar Lakes.

See issue 4.

Canoeing

Canoeing takes place on the River Tamar under an access agreement with the British Canoe Union. The BCU would like to extend the agreement to upstream of Greystone Bridge and to increase the permitted maximum number of canoeists to 40 on one weekend. Such an increase would only be possible with the agreement of landowners and consultation with other riparian interests. There is a need to improve safety at some canoe access points on the Tamar.

Issue 26: To help promote the responsible use of the River Tamar by canoeists.

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5.4 Flood Defence

Targets for flood defence may be prescribed (e.g. the time allowed to determine a flood defence consent), indicative (e.g. relating to the level of flood protection appropriate to a particular land use), or business (e.g. a commitment which the NRA has imposed upon itself to improve efficiency or cost effectiveness).

Serious floods occur less often than minor floods. The term return period describes how often on average a flood might occur. For example a 10 year return period flood might be equalled or exceeded once every 10 years on average (a 10% chance of flooding each year) or a more serious flood once every 100 years, (a 1% chance of flooding each year).

The standard of flood protection at a location is the worst flood (expressed as a return period) which can be withstood without significant flooding. Flood defence schemes only alleviate flooding up to the design standard, a more serious flood may still occur.

We manage flood defence by setting target standards, measuring existing standards, and addressing the difference.

General Targets

Target To manage flood defence by addressing the differences between target and actual standards of service, by 1997.

State The management framework has been agreed, and the techniques are being nationally piloted in 1994/95.

Issue 27: A fully integrated Flood Defence Management Manual and supporting System are required to improve targeting of resources to the greatest needs.

Action A flood defence management system is presently being developed. At the present time it is too early to say when this will be introduced. Our best estimate of time-scale is that introduction will take place during 1997. Data collection is partially controlled by restraints on the current flood defence budget with assets surveys awaiting financial approval to proceed.

During 1995/96 a comparison of the standards of service of maintenance on this catchment area will be carried out. This assessment will identify whether the service being provided to each river reach is too much, about right or too little. Where the assessment shows that too much or too little work is being carried out the NRA will consider whether the amount of maintenance work should be reduced or increased. Major changes will only take place following full analysis of the effects.

Regulation

We advise planning authorities on flood defence matters. We also issue consents and byelaw approvals for certain works which are likely to affect the flow of water or impede any drainage work.

Target To provide planning authorities with sufficient information to ensure that the effects of development on flood risk are properly considered in accordance with the Department of Environment Circular 30/92 'Development and Flood Risk'.¹⁴

State Information is currently provided on the basis of historic flood records and survey data. We have agreed with planning authorities how we can improve this information.

Issue 28: The need to identify flood risk for planning authorities. This should take account of the timetable for preparing district wide Local Plan(s).

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Action It is hoped to produce indicative floodplain information for all catchments as part of Section 105 Survey development and flood risk. A pilot scheme is currently in progress in the St Austell area. Other catchments, including the Tamar, will follow, benefitting from the lessons learned and more accurate assessment of the costs involved. The full programme for the Region is due for completion in 1999 subject to National approval.

Target To ensure that development does not reduce the standard of flood defence and that opportunities for environmental enhancement are taken.

State Development plans for building in the floodplains at Launceston, Holsworthy and Tinchy. The proposed growth of Launceston's industrial estates on land that is currently farmland or open space will increase the amount of surface runoff.

Issue 29: The NRA is concerned about the impact development could have on the headwaters of the Lowley Brook to the south of Launceston.

Issue 30: The NRA is concerned about inappropriate development, particularly in the floodplains, that will affect standards of flood defence and damage environmental interest.

Action The NRA will be liaising closely with NCDC and developers to ensure flood defence standards are maintained or enhanced. It will continue to object to development within the floodplain.

Target To manage water levels properly for farming, flood defence and wildlife.

State The Ministry of Agriculture, Fisheries & Food (MAFF) have issued guidelines for the preparation of water level management plans. Plans are required for those areas, particularly Sites of Special Scientific Interest (SSSI), where it is important to agree how water levels should be managed to balance the interest of farming, flood defence and wildlife.

English Nature have identified two such SSSIs within the catchment, at Brendon and Vealand Fen (NGR SS 281 069) and at Kingford Fen (NGR SS 281 059). There are no water level management plans in place within the catchment.

Issue 31: The need to develop water level management plans for Brendon and Vealand Fen and at Kingford Fen.

Action The priority of these sites require plans to be agreed by 1998. The NRA will work with MAFF, EN and others to develop plans in accordance with the time-scale and guidelines set by MAFF.

Improvements

We can build new flood defences if flooding is a serious problem in a particular area. Nowadays we usually only build new defences to protect built up areas from flooding. All schemes must be technically, economically and environmentally sound. We keep a list of schemes called a Programme of Capital Works which helps us to plan for the future.

Different types of land and property need different levels of protection. We use the indicative standards shown in Table 19 (return period in years) to design schemes.

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Table 19: Indicative standards for the design of Flood Defence Schemes

Band	Current Land Use	Target Standard of Protection (Return Period - years)	
		Sea	River
A	High density urban, containing significant residential and non-residential property	1:100 - 1:200	1:50 - 1:100
B	Medium density urban	1:50 - 1:200	1:25 - 1:100
C	Low density or rural communities. Highly productive farmland	1:10 - 1:100	1:10 - 1:100
D	Generally arable farming with isolated properties	1:2.5 - 1:20	1:2.5 - 1:20
E	Low productivity land with few properties at risk	<1:5	<1:5

Indicative standards are only a guide: they may not always be appropriate.

Further river improvements may be necessary in the future. Once a problem is identified consideration will be given to carrying out a minor improvement. The benefit of such improvements should generally exceed the cost of the work. In deciding whether a scheme is justifiable both environmental and economic benefits are considered.

Target To identify and investigate all flood risk locations.

State We maintain a register of flood problems. These may be identified through a flooding event or through special surveys which the NRA undertake from time to time. Those problems which, after investigation, may justify new or improvement works by the NRA are included on a programme of long term needs from which the capital programme is prepared.

There are currently no sites within the Tamar Catchment which have been identified for investigation or inclusion on the capital programme. However the data used is old and it is felt that it needs to be updated to properly reflect the current situation.

Issue 32: The need to update the database of flood risk locations for potential capital works.

Action Flood problems will be reviewed as part of the development and flood risk survey of this catchment which will be undertaken before 1999.

It is intended that as part of the Section 105 survey development and flood risk that indicative floodplains will be available for the whole catchment. Such plans will clearly show areas requiring further flood protection and highlight where standards of protection falls below that detailed in Table 19. At the present time it is unlikely these will be available until 1997/98 for this catchment area.

Target To provide properly appraised flood defence schemes.

State We undertake a programme of capital works as per our Medium Term Plan which is derived from the Long Term Plan of Needs. At the present time no schemes are present in the medium term plan within this catchment area.

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Emergency Response

Absolute flood protection is not possible. Because of this we need to warn people when there is a danger of flooding. The NRA has a commitment to improve the Level of Service so that where possible a warning is issued at least two hours in advance of flooding.

A study is currently being undertaken to identify where present flood warning arrangements meet this standard and where it is possible to improve the network. Work is also continuing on using weather radar information for early flood warning.

The emergency workforce respond to incidents as they occur throughout the catchment. This involves checking the satisfactory operation of flood schemes and further flood monitoring at river crossing liable to be blocked by debris being carried down river. Assistance is given to landowners in sand-bagging around properties at risk when resources are available. A number of barn conversions built against our advice are particularly vulnerable to flooding.

Target Where possible, to issue a warning at least 2 hours in advance of flooding.

State On the rivers where flood warnings are issued the system has been operated within the target. The warning system is not complete however and the Level of Service study will identify areas where improvements can be made. In advance of this the Rivers Kensey and Lyd have already been included in the current programme for additional flood warning. River levels will be measured far enough upstream of Launceston and Lifton so that flood warning can be given in accordance with the target.

Issue 33: Incomplete flood warning system.

Action Carry out improvements identified above and continue Level of Service study to identify any further areas of need.

Target To operate NRA flood defences to design standards. To prepare and keep up to date a plan for responding to flooding and damaged flood defence structures within specified time limits, depending on location and potential impacts.

During a flood event our prime role is to ensure that the flood capacity of each river is maximized. This is achieved by actioning response Level A and B, these are defined as follows: Level A, checking operational flood defence systems are working properly, this includes operating barriers, closure of flood gates, positioning stop logs, ensure pumping stations are operating, adjusting sluice gates/penstocks etc, ensure flood storage areas are utilized properly. Level B, check river reaches to avoid obstruction of watercourse and monitor river levels, this includes clearance of trash screen, inspect sensitive location where river blockage may occur, carry out surveillance of flood defences to ensure scheme is functioning properly, provide information on river levels to assist in flood warning.

State Response to Level A and B within the catchment area would include the following. Level A, the proposed small pumping station at Bridgerule is the only item within this catchment. Level B, clearance of trash screen on the Wooda Stream Launceston. Inspect major river crossing along River Tamar. Inspect flood defence schemes where flood warnings have been given. This is carried out more frequently on the schemes at Yeolmbridge, River Ottery, Tinhay, River Thrushel, Newport, River Kensey.

The appropriate action to take during each flood event is decided by the Area Base Controller who uses up to date telemetry information plus experience and judgement on need based on priorities elsewhere within the Cornwall Area and available resource.

6.0 TABLE OF ISSUES

6.0 SUMMARY TABLE OF ISSUES

No	Issue	Options for Action	Benefits	Constraints	Responsibility	
					Lead	Others
1	The effects of agricultural activity on water quality.					
	1 Marginal non-compliance with WQO in the River Tamar	All issues * Investigations to identify sources.	Issues 1-3 * Achieve WQOs and environmental improvements.	All issues * Cost	All issues NRA	MAFF, NFU
	2 Marginal non-compliance with WQO for Stowford Bridge on the River Thrushel	* Promote COGAP and farm waste management plans (including farmers self assessment).				MAFF, NFU,CLA
	3 Marginal non-compliance with the WQO for Bolesbridge Water (though recent improvement in water quality)					
	4 Non-compliance with EC Fish Directive Buses Bridge on the River Tamar		* Meet EC Freshwater Fish Directive Standards and achieve environmental improvements.			

No	Issue	Options for Action	Benefits	Constraints	Responsibility	
					Lead	Others
2	The effect of local geology/abandoned mines on water quality.					
	1 RE class 5 at Gunnislake due to elevated copper levels. Exceedence of the Freshwater Fish Directive standard for total zinc at Two Bridges on the Penpont Water.	<ul style="list-style-type: none"> * Fully investigate sources/ component loads * Seek "set aside" or derogation as causes are natural. 	<ul style="list-style-type: none"> * Enable planning * Protects other determinands at a higher level 	<ul style="list-style-type: none"> * Resources * None known 	NRA NRA	District Councils
	2 Exceedence of the EC Dangerous Substances List II EQS for copper in the River Tamar downstream of Hingston Quarry.	<ul style="list-style-type: none"> * Continue monitoring. * Move monitoring point downstream outside mixing zone. 	<ul style="list-style-type: none"> * New monitoring point will give more representative sample 	<ul style="list-style-type: none"> * Cost 	NRA	Quarry owners
	3 Possible future release of metal contaminated water as a result of quarrying activity at Hingston.	<ul style="list-style-type: none"> * Continue monitoring. * Remedial action if contamination increases. 	<ul style="list-style-type: none"> * No deterioration in water quality 	<ul style="list-style-type: none"> * Cost 	NRA	Quarry owners
	4 Inputs of metals from abandoned mines and waste tip sites.	<ul style="list-style-type: none"> * Following national compilation of Annex 1A data reductions in metal loads may have to be sought if point sources can be identified. * Non disturbance of Devon Great Consols spoil tips through planning controls. * Fully investigate sources/ component loads * Seek "set aside" or derogation as causes are natural. 	<ul style="list-style-type: none"> * Improved water environment * Prevent pollution 	<ul style="list-style-type: none"> * Cost * Difficulty in finding point sources * Possible economic loss Issues 2.4 & 2.5 * None known 	NRA NRA NRA NRA/LPA/ Landowner	District Councils

No	Issue	Options for Action	Benefits	Constraints	Responsibility	
					Lead	Others
3	High loads of organic Annex 1A substances in the River Tamar at Gunnislake.	<ul style="list-style-type: none"> * Following national compilation of data investigations may be required to determine the source of these Annex 1A organic substances and reductions in loads may have to be sought. 	<ul style="list-style-type: none"> * Improved water environment 	<ul style="list-style-type: none"> * Cost 	NRA	
4	Eutrophication. 1 Eutrophication of the Tamar Lakes. 2 Possible eutrophication within the Tamar Catchment.	<ul style="list-style-type: none"> * Review reservoir operation * Continue Monitoring. * Carry out investigations. * When complete, carry out recommendations. * Continue Monitoring. * Carry out investigations. * When complete, carry out recommendations. 	All Options <ul style="list-style-type: none"> * Improved water environment * Reduced risk of algal blooms * Extended use for Water Contact sports * improved environment for wildlife 	All Options <ul style="list-style-type: none"> * Cost 	NRA NRA NRA NRA NRA NRA NRA	SWWSL SWWSL SWWSL SWWSL/ land owners Unknown
5	High levels of suspended solids in the Tamar Catchment.	<ul style="list-style-type: none"> * Identify sources. * Quantify impacts. * Review control options. * Carry out control measures. 	All options: <ul style="list-style-type: none"> * Improved water environment 	All Options <ul style="list-style-type: none"> * Cost 	NRA NRA NRA	MAFF MAFF / Land owners
6	Acidic run-off. 1 Low pH in the River Lyd at Lydford 2 Acidic run-off leading to fish kills on the Rivers Kensey and Ottery	<ul style="list-style-type: none"> * Continue monitoring to confirm if caused by natural geology and soils. * NRA to "set aside" pH data. * Mitigation work post-drought to artificially maintain pH. 	<ul style="list-style-type: none"> * Compliance with WQO * Ensures high quality of other determinands is protected * Diminished fish losses 	<ul style="list-style-type: none"> * None known * None known * Cost 	NRA NRA NRA	

No	Issue	Options for Action	Benefits	Constraints	Responsibility	
					Lead	Others
7a	Operation and development of Roadford Reservoir water within the Roadford Strategic supply system.	<ul style="list-style-type: none"> * Modelling of the Roadford Strategic Supply System to determine the yield, best use of available resources and future developments. * Review of reservoir operating rules, in particular the Enhanced Flow Programme. 	<p>All options for action:</p> <ul style="list-style-type: none"> * Efficient use of water resources. * Improved water environment/fishery 	<p>All options for action:</p> <ul style="list-style-type: none"> * Resources * Co-operation of the water Company 	NRA NRA	SWWSL SWWSL
7b	The impact of Roadford reservoir on the Tamar Catchment:	<ul style="list-style-type: none"> * Formalise NRA position statement on the environmental assessment of the water environment to aid determination of revised Gunnislake abstraction licence in 2002. * Full review of fisheries data. * Review of reservoir operating rules, in particular the Enhanced Flow Programme. 	<p>All options for action:</p> <ul style="list-style-type: none"> * Improved water environment/fishery 	<p>All options for action:</p> <ul style="list-style-type: none"> * Resources * Co-operation of the water Company 	NRA NRA NRA	SWWSL SWWSL
8	Lack of knowledge of wildlife flow requirements.	<ul style="list-style-type: none"> * Implement R&D when results become available. * Survey and monitor wildlife. 	<p>All Options:</p> <ul style="list-style-type: none"> * A sound basis for decisions that will improve the health of the catchment. * Efficient use of water resources 	<ul style="list-style-type: none"> * Cost and timescale. * Cost of surveys/ monitoring. 	NRA NRA	Conservation groups, ie EN/DWT/ CWT/RSPB
9	Low flows downstream of Lower Tamar Lake.	<ul style="list-style-type: none"> * Monitoring of compensation flow discharges. * Monitoring juvenile salmon production. 	<ul style="list-style-type: none"> * Maintenance of water quality and habitats and the protection of wildlife and other users. 	<ul style="list-style-type: none"> * Cost 	NRA NRA	SWWSL DWT/ CWT/ CBWPS

No	Issue	Options for Action	Benefits	Constraints	Responsibility	
					Lead	Others
10	Management of Lower Tamar Lake water levels.	* Environmental Assessment.	* Maintenance of water quality and habitats and the protection of wildlife and other users.	* Cost	SWWSL	NRA/ DWT/ CWT/LPAs/ CBWPS/ Canal society/ Angling groups
11	Protection and enhancement of riparian strip.	<ul style="list-style-type: none"> * NRA works carried out to Best Practice. * Encourage landowners to protect riparian strip. * Restoration/ replanting. * Encourage extension of MAFF's buffer zone trial on R Nadder (Wiltshire) if successful. 	All Options <ul style="list-style-type: none"> * Improved water environment for wildlife/fisheries * Reduce bank erosion * improve quality of surface water run off 	All options <ul style="list-style-type: none"> * Cost * Potential loss of flood storage capacity. 	NRA NRA NRA	land owners, conservation bodies MAFF, NFU
12	Develop the protection of existing wetlands, especially Culm grassland, and actively seek opportunities to recreate wetland habitats through strategic planning with other bodies.	<ul style="list-style-type: none"> * Support and promote the use of schemes such as Countryside Stewardship Schemes to encourage landowners to preserve habitats and/or recreate them. * Protection through the planning process. * Advice from NRA and other bodies to be given to landowners. 	<ul style="list-style-type: none"> * Financial help to create habitats. * Strong level of control where permission required. * Low cost. 	<ul style="list-style-type: none"> * Need to inform landowners of grants. * Requires monitoring. * No direct financial incentives for landowners. 	NRA NRA NRA	CoCom/ EN/Land owners Planning Authority EN/ NFU/ FWAG/ CoCom/ CWT/DWT

No	Issue	Options for Action	Benefits	Constraints	Responsibility	
					Lead	Others
13	Removal of blocking trash dams and trimming of overhanging trees preventing passage of fish or impacting spawning gravels.	<ul style="list-style-type: none"> * Clearance undertaken: work carried out to NRA Best Practice. 	<ul style="list-style-type: none"> * Improved access for migratory fish. * Improved spawning environment. * Remove flood risk 	<ul style="list-style-type: none"> * Cost * Potential environmental impact 	NRA	Fishing clubs Landowners
14	Assessment of the natural fishery to confirm benefits of improvement works.	<ul style="list-style-type: none"> * Monitoring fish populations by use of fish surveys/ counters/ and study of rod and net catch returns. 	<ul style="list-style-type: none"> * Establish success of work and benefit of expenditure. 	<ul style="list-style-type: none"> * Resources 	NRA	
15	Decline in catch of multi sea winter salmon. (including spring salmon)	<ul style="list-style-type: none"> * Promote a National NRA investigation into the problems. * Continue monitoring: fish scale analysis / rod and net catches. * Investigate possible byelaws to increase escapement of multi sea winter salmon. 	<ul style="list-style-type: none"> * Provide basis for decision making. * Provide data to assist decision making. * Promote spawning of multi sea winter fish. 	<ul style="list-style-type: none"> * Cost * Cost * Economic implication for users. 	NRA NRA NRA	MAFF MAFF/ Riparian interest/ Fishing clubs
16	Decline in sea trout catch.	<ul style="list-style-type: none"> * Promote a National NRA investigation into decline. * Utilise Gunnislake fish counter to assess changes in adult population. * Scale reading to investigate adult population trends in stock components. * Continue monitoring of rod catches in relation to environmental factors. 	All options: <ul style="list-style-type: none"> * Provide data for decision making. 	All Options: <ul style="list-style-type: none"> * Cost 	NRA NRA NRA NRA	MAFF Fishing clubs
17	Illegal exploitation of salmonids.	<ul style="list-style-type: none"> * Rigorous and high profile enforcement on all salmonid rivers. 	<ul style="list-style-type: none"> * Protect stocks. 	<ul style="list-style-type: none"> * Cost 	NRA	MAFF

No	Issue	Options for Action	Benefits	Constraints	Responsibility	
					Lead	Others
18	Introduction of non-native fish species.	<ul style="list-style-type: none"> * Update database on distribution of non-native species within still water fisheries. * Regular inspections of still water fisheries. * Monitoring of non-native escapees recorded during fisheries work. 	<ul style="list-style-type: none"> * Provide data for decision making. * Reduce illegal non-native introductions. * Provide data for decision making. 	All Options: <ul style="list-style-type: none"> * Cost 	NRA NRA NRA	
19	Poor salmonid recruitment on the River Wolf.	<ul style="list-style-type: none"> * Continuation of Roadford Environmental monitoring and investigations, in particular, effectiveness of Enhanced Flow Programme. 	<ul style="list-style-type: none"> * Provide data to help plan remedial work 	<ul style="list-style-type: none"> * Cost 	NRA SWWSL	
20	Virginstow Ford on R Carey perceived as obstacle to fish.	<ul style="list-style-type: none"> * Investigation into possible improvements to the pipe bridge. 	<ul style="list-style-type: none"> * Improved access for migratory fish. 	<ul style="list-style-type: none"> * Cost 	NRA	DCC Highways
21	Poor salmonid juvenile densities on the River Claw, upper Henford Water, Luckett Stream and the Ogbeare Stream.	<ul style="list-style-type: none"> * Investigation into possible causes and remedial work. 	<ul style="list-style-type: none"> * Optimising the fishery 	<ul style="list-style-type: none"> * Cost 	NRA	
22	Review status of otters in the catchment to ensure its needs are protected.	<ul style="list-style-type: none"> * Otter recording; monitoring and post mortem examinations through the National NRA Otter Strategy. 	<ul style="list-style-type: none"> * Establish success of work and benefit of expenditure. 	<ul style="list-style-type: none"> * Resources 	NRA Vincent Wildlife Trust/ Other conserv- ation bodies	

No	Issue	Options for Action	Benefits	Constraints	Responsibility	
					Lead	Others
23	Assess the extent and impact of invasive species.	<ul style="list-style-type: none"> * Assess extent and impact on NRA owned land and draw up appropriate programmes for treatment according to NRA policy and R&D. * Assess extent and impact throughout the catchment and encourage riparian owners to take appropriate action. 	Both Options: <ul style="list-style-type: none"> * Prevent impact on native species. 	<ul style="list-style-type: none"> * Cost * Cost * Willingness of land owners to carry out appropriate action. 	NRA NRA Conserv- ation bodies	Land owners FWAG/ MAFF/LPAs
24	Lack of detailed archaeological information.	<ul style="list-style-type: none"> * Undertake Assessment of water related resource. * Undertake general archaeological assesment. * Liaison with relevant external groups. 	<ul style="list-style-type: none"> * Ensure full consideration of archaeological sites in NRA work. * Ensure adequate protection 	<ul style="list-style-type: none"> * Resources 	NRA LPAs/ DAU/ CAU	LPAs/ DAU/ CAU English Heritage
25	The development of recreational paths.	<ul style="list-style-type: none"> * Promote permissive paths. * Liaison between interested groups. * Use of access payments in grants such as Countryside Stewardship and Farm Woodland grant. * Complete NRA Recreational survey. 	<ul style="list-style-type: none"> * Low cost. * Prevent conflicts of interest, optimise resources and avoid duplication of effort. * Financial inducement to help land owners to open and manage their resource. * Highlight areas needing management or opportunities to increase use. 	<ul style="list-style-type: none"> * Voluntary in nature * Resources * Potential conflict with established users and conservation interests. * Resources 	LPA's LPA's/ landowners/ fishing clubs NRA CoCom Land owners NRA	Conserva- tion bodies Land owners/ LPAs/ Public/ Bodies/ CoCom NRA

No	Issue	Options for Action	Benefits	Constraints	Responsibility	
					Lead	Others
26	To help promote the responsible use of the River Tamar by canoeists.	<ul style="list-style-type: none"> * Promote access agreements * Provision of notice boards on riverside to publicise agreements. * Improved Access/Exit points. 	All Options: <ul style="list-style-type: none"> * Control access through responsible organisations and minimise conflict. 	<ul style="list-style-type: none"> * None known. * Cost * Cost 	BCU BCU/NRA BCU/NRA	Riparian owners/ NRA
27	A fully integrated Flood Defence Management Manual and supporting System to improve targeting of resources to the greatest needs.	<ul style="list-style-type: none"> * Develop system. 	<ul style="list-style-type: none"> * Efficient use of resources 	<ul style="list-style-type: none"> * Disruption in implementing change. 	NRA	
28	Identification of flood risk to Planning Authorities.	<ul style="list-style-type: none"> * NRA pilot scheme underway. Subject to National approval, all SW catchments to be covered by 1999. 	<ul style="list-style-type: none"> * Improved information for planning authorities * Lessen risk of potential flooding 	<ul style="list-style-type: none"> * Cost 	NRA	LPAs
29	Increased surface water runoff to Lowley Brook.	<ul style="list-style-type: none"> * Plan development to prevent excess runoff. 	<ul style="list-style-type: none"> * No overloading of Lowley Brook 	<ul style="list-style-type: none"> * None known 	NRA	NCDC/ Developer
30	New development in flood plains.	<ul style="list-style-type: none"> * Plan development to prevent flooding. 	<ul style="list-style-type: none"> * No additional flooding problems. 	<ul style="list-style-type: none"> * None known 	District Councils	NRA/ Developer
31	Need to develop water level management plans for Brendon and Vealand Fen and at Kingford Fen.	<ul style="list-style-type: none"> * Develop management system for these sites taking account of the needs of farming, flood defence and wildlife. 	<ul style="list-style-type: none"> * Improved water environment 	<ul style="list-style-type: none"> * None known 	NRA	MAFF/ EN/ others
32	The need to update NRA database of flood risk locations for potential capital works.	<ul style="list-style-type: none"> * Section 105 survey of catchment. 	<ul style="list-style-type: none"> * Updated information on flooding problems 	<ul style="list-style-type: none"> * None known 	NRA	
33	Incomplete flood warning system.	<ul style="list-style-type: none"> * Continue Level of Service study. * Install additional flood warning stations on Rivers Lyd and Kensey. 	Both options <ul style="list-style-type: none"> * Improved flood warning 	Both options <ul style="list-style-type: none"> * Cost 	NRA NRA	

APPENDICES

APPENDIX A

SSSI DESIGNATIONS

CULM GRASSLAND

Ten SSSIs in the Tamar catchment are designated for Culm grassland; traditionally managed, unimproved, acid grassland; displaying a range of herb-rich mire and swamp communities, several of which are nationally scarce and restricted to South West Britain.

Dunsdon Farm	39.2 ha
Brendon and Vealand Fen	18.3 ha
Kingford Fen	7.4 ha
Small Brook	14.7 ha
Lymsworthy Meadow	7.7 ha
Grimscott	0.87 ha
Greenamoor	37.54 ha
Brendonmoor	11.7 ha
Ottery Valley	32.48 ha
Kernick and Ottery Meadows	29.77 ha

The Citation Sheet for Brendonmoor is a typical example of a Culm SSSI.

Description and Reasons for Notification

Brendonmoor is a fragment of a formerly extensive moorland and mire system on the Carboniferous Culm Measures of North Cornwall. The extent of such un-improved "culm grasslands" is known to have diminished by over 1/3 in neighbouring Devon, between 1984 - 1989 and Brendonmoor is only one of four such sites in Cornwall where considerable losses have taken place. It lies in gently rolling farmland close to the watershed between the catchments of the rivers Ottery and Tamar, about 12 kilometres south south-east of Bude. The moor has developed on clayey soils overlying shale, mainly of the Halstow series.

The site supports a good example of the *Molinia caerulea*, *Cirsium dissectum*, *Juncus acutiflorus*, *Erica tetralix* fen meadow community.

Vegetation ranges across the site from communities dominated by Purple Moor Grass (*Molinia caerulea*), with abundant Compact Rush (*Juncus conglomeratus*) to areas supporting herb rich vegetation including sedges (*Carex panicea*, *C. pulicaris* and *C. hostiana*), Meadow Thistle (*Cirsium dissectum*), Woodrush (*Luzula multiflora*), Common Tormenitl (*Potentilla erecta*), Devils-bit Scabious (*Succisa pratensis*) and Creeping Willow (*Salix repens*). Bryophytes are also represented including *Campylium stellatum*, *Leucobryum glaucum*, *Breutelia chrysocoma*, *Sphagnum auriculatum* and *S. subnitens*. The discomycete Eye-lash Fungus (*Scutellinia scutellata*) is present. Drier localities support Heather (*Calluna vulgaris*), Western Gorse (*Ulex gallii*) and the local species Petty Whin (*Genista anglica*). Wetter, more acid areas are characterised by rushes (*Juncus* spp.) and sedges (*Carex* spp.), Greater Birds-foot Trefoil (*Lotus uliginosus*), Cross-leaved Heath (*Erica tetralix*), Bog Pimpernel (*Anagallis tenella*), Bog Asphodel (*Narthecium ossifragum*), Common Cottongrass (*Eriophorum angustifolium*) and Pale Butterwort (*Pinguicula lusitanica*). The nationally scarce species Wavy-leaved St John's Wort (*Hypericum undulatum*) is also present.

A marshy Soft Rush (*Juncus effusus*) dominated soakaway is present supporting species such as Bog Stüchwort (*Stellaria alsine*), Ragged Robin (*Lychnis flos-cuculi*) and Meadow Sweet (*Filipendula ulmaria*).

APPENDIX A

At the western end of the site is an area of Bramble (*Rubus* spp.) scrub, Birch (*Betula* spp.) and Alder (*Alnus* sp.) woodland which demonstrates the transition from fen to a woodland community. A population of the Marsh Fritillary Butterfly (*Eurodryas aurinia*) is present and in winter the wetland supports large numbers of Snipe (*Gallinago gallinago*).

OTHER SSSIs

Lydford Gorge

- combines features associated with gorge formation and 'river capture' with fine examples of ancient oak-hazel woodland developed on the steep slopes. The site is also important for its bryophytes and supports several uncommon moss species.

Greenscombe Wood, Luckett

- various woodland types, including semi-natural ancient woodland, with associated species-rich rides and margins. Important breeding site for the nationally endangered Heath Fritillary butterfly and habitats for at least 80 other lepidoptera species.

The eastern and western extremities of the catchment lie in parts of the **North Dartmoor** and **Bodmin Moor** SSSIs.

Sites designated for their features of geological importance are:

- Yeolmbridge Quarry
- Lidcott Mine
- Polyphant
- Stourscombe Quarry
- Greystone Quarry

APPENDIX A

Cornwall Nature Conservation Sites

	Site Name	NGR	CWT Ref.
1.	Eastcott Moor	SS 270 174 - SS 259 159	NC6.13
2.	Wrasford Moor	SS 261 138	NC27
3.	Tamar Lakes	SS 291 105 - SS 280 134	NC6.12
4.	Lymsworthy	SS 273 108	NC16
5.	Moreton Farm	SS 27 07	NC60
6.	Upper Tamar Woods	SX 303 993 - SX 328 932	NC6.11
7.	Ogbeare Wood	SX 30 96	NC67
8.	Brendon Moor	SX 26 95	NC73
9.	Langdon	SX 20 92	NC63
10.	Ottery Valley	SX 174 909 - SX 182 930	NC29
11.	Creddacott	SX 23 95 - SX 24 95	NC69
12.	Beardon Wood	SX 300 930	NC47
13.	Tregerry and Higher Scarsick	SX 21 89 - SX 20 88	NC48
14.	Petherwin/Vicarage Woods	SX 28 89	NC51
15.	Weston Wood	SX 29 88	NC52
16.	Abbot's Hendra	SX 19 86	NC62
17.	Napp's Moor	SX 22 85	NC20.2
18.	Laneast & Badgall Downs	SX 228 857	NC20.1
19.	Tregeare Down	SX 250 870 - SX 276 858	NC21.1
20.	Red Down and Athill Wood	SX 250 870 - SX 276 858	NC21.2
21.	Trevallet Wood	SX 281 849 - SX 297 847	NC13
22.	St Clether	SX 206 839	NC19
23.	Laneast Valley	SX 22 83 - SX 23 83	NC72
24.	Trelaske Wood	SX 290 808	NC30.1
25.	Northdown Plantation	SX 25 82	NC41
26.	West Petherwin Wood	SX 31 82	NC53
27.	Landlake Wood	SX 326 824	NC32
28.	Bradford Wood	SX 363 799 - SX 391 757	NC6.10
29.	Ruses Mill	SX 341 752	NC30.12
30.	Halwell Wood	SX 30 77	NC/CN30.2
31.	Lower Larrick Wood	SX 313 776	NC30.10
32.	Higher Trefrize Wood	SX 30 77	NC30.3
33.	Armstrong Wood	SX 321 772	NC30.11
34.	Tregrove Wood	SX 32 76	NC30.5
35.	Trerefters Wood	SX 32 76	NC30.6
36.	Great Wood	SX 33 76	NC30.7
37.	Penrest Wood	SX 337 772	NC30.8
38.	Call & Westhill Woods	SX 337 767	NC/CN30.9
39.	Watergate Wood to Woodabridge	SX 341 752 - SX 343 769	NC31
40.	Deer Park Wood	SX 37 73 - SX 38 73	NC68
41.	Luckett Reserve & Greenscombe Wood	SX 388 734 - SX 398 721	NC/CN6.9
42.	Clitters Wood	SX 41 72	CN6.8
43.	Kit Hill	SX 37 71	NC/CN8

APPENDIX B

Analysis of historic Tamar catchment electric fishing surveys

Upper Tamar and tributaries: Juvenile salmon densities at routine sites have been consistently poor although higher numbers of salmon fry have been recorded on some of the rehabilitated gravel areas in 1992 and 1993. There is little indication of significant trout spawning in the upper Tamar region. This probably accounts for a low adult population. Redd counts within the Upper Tamar area showed few salmonid redds spread over a large area.

The smaller upper Tamar tributaries are rarely used by salmon and no juveniles have ever been recorded on the Derril water, Smallbrook and Tala water. These streams do not support good trout populations possibly due to pollution, trash dams and high silt loadings. The most northerly salmon record in the catchment was at South Forda (SS 2765 1105) on The Lamberal Water where two salmon year classes were present in 1971. Salmon have not been recorded since on the Lamberal water although this tributary supports a good trout population.

Main Tamar (downstream of R Ottery confluence): Riffle surveys (a kind of electric-fishing survey -see glossary) showed a marked increase in the abundance of salmon fry and parr downstream of the River Ottery confluence, with a further rise around the River Lyd confluence. Good numbers of salmon fry and parr were present on riffles between the Lyd and Inny. Juvenile salmon numbers were reduced just downstream of the River Inny confluence although salmon parr numbers had risen again by Lamerhoo Ford. Trout abundance could not be assessed from purely riffle surveys. All juvenile salmonids found were fast growing and very healthy.

River Deer: In 1990 small numbers of salmon fry were found at 5 out of 7 survey sites. Until then juvenile salmon densities had been negligible. Although large areas of the River Deer produced few trout fry there are two notable exceptions at Honeycroft Bridge and Chilsworthy. These high trout fry densities are probably a result of brown trout rather than sea trout spawning. Improved densities of 1+ and older trout have been found in the uppermost reaches.

River Claw: No juvenile salmon were found at survey sites on the River Claw in 1984 and 1990. In 1993 salmon fry were found at 4 out of 6 sites with a peak in densities at Clawton Bridge. However overall production was still low. Trout fry production was very limited throughout even in the upper reaches. 1+ and older trout densities were good at Claw Bridge and decreased downstream. Low numbers of 1+ and older trout may be due to farm pollution problems in the area.

River Ottery: The 1993 survey revealed excellent salmon fry production throughout the River Ottery. The results are a major improvement over historic figures and include a number of the highest salmon fry densities recorded during the 1993 Tamar survey. A new survey site on the Caudworthy Water at South Wheatley revealed a good salmon fry density in an area made more accessible by river clearance work in 1992. Salmon parr densities on the River Ottery in 1993 improved on 1984 and 1990 results although have not yet reached 1971 levels. Excellent trout fry densities were strongly concentrated in the upper River Ottery and its upper tributaries as a result mainly of sea trout spawning. Downstream of Canworthy Water village negligible trout spawning was apparent on the main River Ottery or tributaries. 1+ and older trout densities were good on the upper parts of the River Ottery and on the Tucking Mill stream (known as Canworthy Water).

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River Carey: Generally low salmon densities currently characterise the River Carey downstream of Ashmill. Migration past Ashmill Weir was assisted by installation of a Baulk fish pass in October 1992. The high salmon parr production of 1971 provides a target suggesting improvements in parr production could still be made. Trout fry production is good in the headwaters and on the lower part of the Henford Water but limited elsewhere. The Dury Water currently has a small trout population although it was devoid of salmonids in 1984. Good densities of older trout were present in the upper reaches of the River Carey and on the Henford Water. However trout and bullheads are no longer present at the upstream site on the Henford Water even though this site held a small population as recently as 1990.

River Kensey: Salmon fry densities were moderate and salmon parr densities poor on the River Kensey although improvements have occurred in distribution since the building of a fish pass at Ridgegrove in 1976 and a Baulk fish pass at Newmills. The upper River Kensey is an important sea trout spawning area with regularly high fry concentrations at Badgall and on the Down Stream. Negligible trout spawning occurs below the Down Stream confluence. 1+ and older trout are present in good numbers throughout.

River Lyd: The River Lyd, the River Lew and the Quither brook are highly productive for juvenile salmon. Salmon parr densities are variable within the survey sites but are good overall. Reasonable trout fry and parr densities are usually found in the Lydford Gorge to Coryton area. The Quither brook supports a consistently good population of 1+ and older trout. During October 1992 a Modular Denil fish pass was constructed on the Lew near Bridestowe to aid upstream salmonid migration. Juvenile salmon have since been found upstream of the fish pass together with good trout fry densities. 1+ and older trout densities are excellent throughout the River Lew.

There have been significant fish kills in the lower reaches of the Lyd associated with pollution incidents.

River Thrushel: Salmon fry densities are reasonable with peaks below the River Wolf confluence, however salmon parr and trout fry numbers are generally low. There are good 1+ and older trout densities in the upper reaches. Trash dams are a recognised problem and removal should be a priority.

River Wolf: Salmon fry densities dropped in 1993 but had improved again in 1994. Natural salmon parr production is low except in the lower reaches. Salmonids reared for the Roadford Mitigation Scheme are released below Roadford Reservoir. The numbers of trout fry and parr numbers on the River Wolf are quite low.

Lowley Brook: The salmon fry densities found on the Lowley Brook in 1993 were good at the middle and lower sites. Salmon parr densities naturally peak at the downstream site. Trout fry densities are fairly low with moderate numbers of 1+ and older trout.

River Inny: There are good salmon fry and parr densities throughout the main River Inny and Penpont Water. Trout fry densities are higher in the River Inny headwaters and good throughout the Penpont Water, peaking at Bowthick. 1+ and older trout densities are reasonable on the River Inny, with good densities from the headwaters to Hicks Mill and throughout the Penpont. Although the Penpont Water is highly productive for salmon and trout certain fish species are rarely found, including Stoneloach. Minnow and Grayling, although present throughout the main River Inny have never been found on the Penpont Water.

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Lana Lake: The Lana Lake supports a limited trout population and very small numbers of salmon have been found at the lowest site in 1971 and 1993. Trash dams on the Lana Lake which may have been impeding salmonid migration were cleared in 1994.

Ogbeare Stream: Only one year class of trout was present in very low numbers at the Tamerton farm site. Historic results suggest a reduction in the salmonid population has occurred since 1984 but the reason for this is unknown.

Lower Tamar streams

Kelly Stream supported a very good density of salmon fry in 1993 but low salmon parr and trout densities.

Small numbers of salmon were present in Damerall Stream and a reasonable trout population. No salmon and a very low trout density in the River Luckett was recorded in 1993. Contributory factors are likely to include the high total copper levels, although a healthy trout population is found in the Portontown Stream which has similar copper levels. The metal levels are on the Portontown Stream are sufficient to cause high mortality in Atlantic salmon and may explain the complete lack of salmon recorded in previous surveys on this stream.

A potentially large abstraction (licence of entitlement) in the headwaters is of concern, particularly in relation to the high trout densities. The absence of salmon requires investigation. Trash dam clearance may improve spawning access for migratory salmonids.

APPENDIX B

Summary Results of Routine River Tamar Electric-fishing Survey 1993

RIVER	SITE	NGR	DATE	SURVEY TYPE	CLUSTER	POPULATION DENSITIES (No. / 100m ²)				OTHER SPECIES
						TROUT 0+	TROUT =>1+	SALMON 0+	SALMON =>1+	
TAMAR	Vivworthy	SS 298 103	04/06/93	DIP	*	P	A	A	A	E.B,SL,M
	Moreton Mill	SS 284 086	04/06/93	DIP	*	A	P	P	A	E.B,SL,M,R
	Great Moreton	SS 281 071	19/08/93	DIP	*	P	P	P	P	E.B,SL,M
	Laffacott	SX 333 940	19/08/93	DIP	*	A	P	P	P	B,SL,M
	Boyton	SX 329 925	19/08/93	DIP	*	A	A	P	A	B,SL,M,G
	Bridgecove	SX 343 897	19/08/93	DIP	*	A	A	P	A	B,SL,M
	D/S Netherbridge	SX 350 867	18/08/93	DIP	*	A	P	P	P	E.B,SL,M
	U/S Polson Bridge	SX 356 849	18/08/93	DIP	*	A	A	P	P	E.B,SL,M,L
	Wishworthy	SX 374 842	18/08/93	DIP	*	A	A	P	P	E.B,SL,M
	Lewhinton	SX 369 823	18/08/93	DIP	*	A	P	P	P	E.B,SL
	D/S Greystone Br	SX 369 803	17/08/93	DIP	*	A	P	P	P	E.B,SL
	Lowley Confluence	SX 366 787	16/08/93	DIP	*	A	A	P	P	E.B,SL, L
	Gravel	SX 384 776	17/08/93	DIP	*	A	A	P	P	E.B,SL, L
	Leighwood Waterfall	SX 384 779	16/08/93	DIP	*	A	A	P	P	E.B,SL
	Southcombe	SX 393 759	16/08/93	DIP	*	A	P	P	P	E.B,SL, L
	U/S Lamerhoe Ford	SX 397 733	27/08/93	DIP	*	A	A	P	P	E.B,SL
LAMBERAL WATER	Forda	SS27651105	01/07/93	1 RUN	I	2.6	9.5	0	0	B, M,L
	Moreton Pound	SS27550895	29/06/93	3 RUN	I	0.7	9.2	0	0	E.B,SL,M
SMALLBROOK	Headon	SS30900725	03/09/93	1 RUN	J	4.3	0	0	0	B, M,L
	Youlton	SS29900510	26/07/93	1 RUN	J	0	0	0	0	SL,M
	Scotland	SS28100425	03/09/93	3 RUN	J	0	2.8	0	0	B,SL,M
DERRIL WATER	Monks	SS30250200	26/07/93	1 RUN	I	1.1	0	0	0	B,SL,M,L
	Yeomaddon	SS30150045	03/08/93	1 RUN	I	0	0	0	0	E.B,SL,M,L
DEER	Honeycroft Bridge	SS32900830	27/06/93	1 RUN	X	54.9	0	0	0	B,SL, L
	Babington Bridge	SS33050706	27/06/93	3 RUN	X	0.8	13.8	0	0	B, M,L
	Ouliver Bridge	SS33560503	27/06/93	1 RUN	X	0.6	7.2	0	0	B,SL,M,L
	Darnton Bridge	SS33750325	26/06/93	1 RUN	Y	0	9.4	0	0	B,SL,M
	Winscott Bridge	SS33840143	25/06/93	1 RUN	Y	0	1.6	0.3	0	B,SL,M
	Forda Mill	SX32559972	26/06/93	3 RUN	Y	0	6.2	0	0	E.B,SL,M
	Deer Bridge	SX31959741	25/06/93	1 RUN	Y	0.3	6.7	0	0.9	E.B,SL,M, D
CHILSWORTHY	Chilsworthy	SS33170510	24/06/93	3 RUN	Z	29	1.0	0	0	B, M,L
DUNSTABLE	Stanbury Cross	SS35140478	24/06/93	1 RUN	Z	0	4.2	0	0	B, M,L
	Dunstable	SS33830314	24/06/93	1 RUN	Z	0	16.0	0	0	B, SL
WHIMPLE BROOK	Whimble Brook	SS34040188	24/06/93	1 RUN	Z	0	0.8	0	0	E, SL,M
CLAW	Higher Claw	SS38900234	28/06/93	1 RUN	V	0.8	7.0	0	0	B,SL,M,L
	Claw Bridge	SS37550073	30/06/93	1 RUN	V	0.9	15.6	4.8	0	E.B,SL,M
	Clawton Bridge	SX35259932	28/06/93	3 RUN	V	0.7	8.8	11.9	0	E.B,SL,M,L
	Gunnacott	SX34159838	29/06/93	1 RUN	V	0	4.2	0.6	0.8	B,SL,M
	Tetcott Bridge	SX32579688	26/06/93	3 RUN	*	0	0.9	4.3	0.3	B,SL,M
CLAW	Art.Spawn.Bed-A	SX 324 968	26/06/93	DIP	*	A	A	P	A	B,SL,M
	Art.Spawn.Bed-B	SX 324 967	26/06/93	DIP	*	A	P	P	A	B,SL,M
	Art.Spawn.Bed-C	SX 324 966	26/06/93	DIP	*	A	A	P	A	E.B,SL,M
	Art.Spawn.Bed-D	SX 323 965	26/06/93	DIP	*	A	A	P	A	B,SL
DOWN STREAM	Bedfordick	SX35209933	28/06/93	1 RUN	V	4.3	0	0	0	E.B,SL,M,L

APPENDIX B

RIVER	SITE	NGR	DATE	SURVEY TYPE	CLUSTER	POPULATION DENSITIES (No. / 100m2)				OTHER SPECIES
						TROUT 0+	TROUT =>1+	SALMON 0+	SALMON =>1+	
OGBEARE	Tamerton Farm	SX32159573	08/06/93	2 RUN	*	0	1.2	0	0	E.B,SL,M
LANA LAKE	Stoney Bridge	SX34059587	10/06/93	1 RUN	H	1.5	2.8	0	0	B,SL,M
	Laffincott	SX32909475	23/07/93	3 RUN	H	0	2.9	1.1	0	B,SL,M
TALA WATER	Bullapit	SX32458950	05/07/93	3 RUN	*	0	6.8	0	0	E.B, L
	Eggbeare	SX34108914	30/06/93	3 RUN	*	0	6.9	0	0	E.B,SL,M,L
OTTERY	Otterham Mill	SX17509110	23/07/93	1 RUN	AQ	81.3	9.3	39.3	1.8	E.B,SL
	Trevilian	SX18009265	07/07/93	3 RUN	AQ	33.8	16.9	83.5	7.3	B, ML
	US Trengune Bridge	SX18809326	11/08/93	1 RUN	AR	17.6	11.0	83.5	4.5	B,SL
	Trengune	SX19209315	10/08/93	1 RUN	AR	17.3	17.5	49.8	0.9	E.B,SL,M,L
	High Wires	SX21309185	16/08/93	1 RUN	AR	9.3	21.0	51.1	8.7	B,SL,M,L
	Canworthy Water	SX22859170	10/08/93	3 RUN	AR	0	5.4	48.1	10.0	E.B,SL,M,L
	Bray Wood	SX23409010	18/08/93	1 RUN	AR	0.6	7.7	39.2	2.8	E.B,SL,M,L,ST
	Penrose	SX25208915	11/08/93	1 RUN	AR	0.4	5.9	25.2	7.1	E.B,SL,M,L,ST
	Penbeale	SX27168865	18/08/93	1 RUN	AS	0	3.7	22.5	2.3	E.B,SL,M,L
	Hollescott	SX29108758	20/08/93	1 RUN	AS	0.1	7.2	12.5	3.2	E.B,SL,M,L,ST
	Yoolm Bridge	SX31108735	19/08/93	3 RUN	AS	0.2	6.3	7.0	3.1	E.B,SL,M,L,ST
	Werrington Park	SX33908666	20/08/93	1 RUN	AS	0.2	6.1	2.1	2.4	B,SL,M,L,ST
NEWHAM TRIB	Newham	SX17909277	23/06/93	1 RUN	AQ	42.9	2.3	225.0	3.6	B,SL, L
TRELASH TRIB	Trelash	SX18859300	18/06/93	2 RUN	*	31.8	4.6	22.6	1.4	B,SL, L
TUCKINGMILL TRIB	Tuckingmill	SX22409140	06/07/93	3 RUN	AV	0.8	23.0	90.5	9.1	E.B,SL,M,L
WITHEVEN	Witheven	SX22559185	22/06/93	1 RUN	AV	1.5	5.2	31.6	5.4	B,SL,M,L
CAUDWORTHY	South Wheatley	SX 241 927	05/08/93	3 RUN	*	1.3	0.9	38.4	0	E.B,SL,M,L
	Caudworthy	SX26708890	23/06/93	3 RUN	*	0	7	3.8	6.0	B,SL,M,L
BOLFSBRIDGE	Bolfsbridge	SX29308780	09/08/93	3 RUN	*	0	12.0	7.9	1.7	E.B,SL,M,L
CAREY	Halfwill Moor	SS42460077	21/07/93	3 RUN	AX	15.1	0	0	0	B,SL,M,L
	Halfwill Bridge	SX42059853	21/07/93	1 RUN	S	5.3	13.6	1.7	0	B,SL,M,L
	Dury Ford	SX40309670	22/07/93	1 RUN	S	0	20.2	0.5	0	B, ML
	Ashnall Bridge	SX39439545	22/07/93	3 RUN	S	0.3	8.9	2.1	1.3	E.B,SL,M,L
	Middle Bridge	SX37119267	22/07/93	1 RUN	T	1	11.7	1.1	1.2	E.B, M
	Boldford Bridge	SX36458837	03/09/93	1 RUN	T	0	9.6	9.7	1.2	E.B,SL,M,L
	Heale Bridge	SX35948624	02/09/93	3 RUN	T	0	5.9	4.6	4.7	E.B,SL,M,L
COOKWORTHY STR	Cookworthy Buddle	SS42200105	21/07/93	1 RUN	AX	22.2	1.2	0	0	B
HALWILL WATER	Halfwill Water	SX42059845	21/07/93	1 RUN	U	10.1	8.3	2.0	0	B,SL,M,L
DURY WATER	Dury Water	SX40109654	21/07/93	1 RUN	U	2.0	5.8	0	0	E.B,SL,M
HENFORD WATER	West Venn Bridge	SX37159667	13/07/93	1 RUN	U	0	0	0	0	B, L
	Henford Bridge	SX37389481	12/07/93	3 RUN	U	38.5	24.1	3.6	0	E.B,SL,M,L
KENSEY	Badgall	SX23058695	08/06/93	3 RUN	AG	100.0	10.2	18.6	0	F, L
	Treburrow	SX25458730	22/06/93	1 RUN	AG	13.7	10.0	0.9	0	B,SL, L
	Egloskerry	SX26658645	22/06/93	1 RUN	AG	9.5	8.3	10.4	1.3	B,SL, L
	Tredidon	SX28368513	22/06/93	1 RUN	AG	0.5	9.1	4.4	0.4	B, L
	Trewithic	SX29558494	23/04/93	1 RUN	AF	2.1	12.3	7.5	1.8	E.B, M,L,G
	New Churches	SX32258508	23/04/93	3 RUN	AF	1.5	7.3	0.3	3.0	E.B, M,L,G
	St. Leonards	SX34788470	23/06/93	1 RUN	AF	0	4.1	1.9	1.2	E.B,SL,M,L

APPENDIX B

RIVER	SITE	NCR	DATE	SURVEY TYPE	CLUSTER	POPULATION DENSITIES (No. / 100m ²)				OTHER SPECIES
						TROUT 0+	TROUT =>1+	SALMON 0+	SALMON =>1+	
BADHARLECK STR	Dove Stream	SX26588620	10/06/93	1 RUN	AG	49.7	14.8	9.8	0	B,SL, L
LYD	Langham	SX48008335	30/07/93	1 RUN	AI	9.7	12.9	36.6	2.7	E,B, ST
	Coryton Bridge	SX46408318	31/07/93	3 RUN	AI	5.4	15.6	29.1	4.0	E,B
LEW	Ebbaford	SX52058975	30/07/93	3 RUN	*	53.4	37.3	5.9	1.7	B, L
	Stone	SX50258920	02/08/93	1 RUN	AK	12.8	17.1	114.2	14.5	E,B,SL,M,L
	Foxcombe	SX47908745	04/08/93	2 RUN	AK	4.9	11.0	35.8	3.3	E,B,SL,M,L,ST
	Lew Mill	SX47008422	31/07/93	1 RUN	AL	1.9	11.0	37.0	2.0	E,B,SL,M,L,ST
	Lew Wood	SX45538488	26/08/93	3 RUN	AL	5.3	26.3	23.7	6.8	E,B,SL,M,L,Q,ST
	Lew	SX44258348	27/08/93	1 RUN	AL	4.3	15.0	43.7	7.3	E,B,SL, L,ST
QUITHER BROOK	Chilston	SX43458195	02/08/93	1 RUN	AJ	13.0	9.9	52.3	0	E,B
	Quither Brook	SX42628360	29/07/93	3 RUN	AJ	3.3	16.4	61.5	0.8	E,B
THRUSHEL	Oatmill	SX51509230	29/07/93	1 RUN	AM	7.6	17.9	0.3	0	B,SL, L
	Great Burrow	SX49459110	30/07/93	3 RUN	AM	0.2	6.8	0	0	E,B,SL,M,L,ST
BREAZLE WATER	Breazle Water	SX44908935	03/08/93	3 RUN	*	1.1	8.5	0.7	0	B,SL,M,L
WOLF	Broadwood	SX 414 888	27/08/93	1 RUN	AU	1.6	6.2**	0	7.1**	E,B,SL,M
KELLY	Bawcombe Farm	SX37108230	01/07/93	3 RUN	*	0	5.3	25.2	2	E,B,SL,M,L
LOWLEY BROOK	Hardon Bridge	SX33558190	01/07/93	1 RUN	AF	7.3	7.9	0	0.5	E,B,SL, L
	Little Cornfort	SX34578045	30/06/93	3 RUN	AF	3.2	8.5	53.6	1.2	E,B,SL,M,L
	Lowley Foot	SX36357865	01/07/93	1 RUN	AF	0.4	6.1	28.1	10.9	E,B,SL,M,L
DNNY	Treglasta	SX18138590	04/08/93	1 RUN	AN	24.1	25.3	83.7	1.1	E,B,SL,M
	St. Clether	SX20588408	03/08/93	3 RUN	AN	10.0	9.3	59.9	3.9	E,B,SL,M,L
	US Lancaster Bridge	SX 224 835	06/08/93	3 RUN	AO	7.6	19.9	37.5	11.3	E,B,SL, L
	Treves	SX25358312	07/08/93	1 RUN	AO	6.4	13.1	21.6	5.5	E,B,SL, ST
	Hicks Mill	SX26608202	13/07/93	1 RUN	AO	1.5	23.6	8.4	7.6	E,B,SL,M,L,G
	Treguddick	SX27838145	12/07/93	1 RUN	AP	2.8	6.5	35.3	8.0	E,B,SL,M,L,G
	Knights Mill	SX29788032	07/08/93	1 RUN	AP	0.8	7.1	10.8	6.9	E,B, ST,SS
	Kilbury	SX30427833	06/07/93	1 RUN	AP	1.2	3.8	22.6	8.4	E,B, M
	Trecarrell	SX32277710	06/07/93	1 RUN	AP	1.6	4.3	37.0	19.1	E,B,SL,M,L
	Trekennar Mill	SX33747708	07/07/93	1 RUN	AP	2.5	7.9	46.4	20.6	E,B,SL
	Bealsmill	SX36147708	08/07/93	3 RUN	AP	1.2	3.4	43.3	13.3	E,B,SL,M,L,ST
	Inny Foot	SX37807794	12/07/93	1 RUN	AP	0.3	1.2	2.4	7.0	E,B,SL,M, ST
PENPONT WATER	Bowthick	SX18458275	01/06/93	3 RUN	AU	41.9	24.5	45.2	5.2	E,B, L
	Trekennick	SX21408148	03/06/93	1 RUN	AU	3.5	12.0	5.4	0	E,B, L
	Troxmaine	SX22628165	29/06/93	1 RUN	AU	22.2	11.9	19.4	6.4	E,B, L
	Trenthick	SX24358205	29/06/93	3 RUN	AW	8.2	8.7	9.0	1.3	E,B, L
	Finches Bridge	SX26008148	30/06/93	1 RUN	AW	15.6	23.3	25.0	5.0	E,B, L
	Art.Spawn.Bed-A	SX26808148	13/08/93	3 RUN	AY	8.3	15.9	79.9	9.0	E,B, L
	D/S Spawn.Bed-B	SX26838152	13/08/93	1 RUN	AY	13.6	22.2	46.1	7.8	E,B, L
WEST CARNE	West Carne	SX19808245	02/06/93	1 RUN	AU	1.8	21.6	0	0	E, L
BUDDLE BROOK	Horsbridge	SX 399 755	18/06/93	1 RUN	AT	4.3	8.3	1.4	2.4	E,B,SL
LUCKETT	Lockett	SX39107365	03/06/93	1 RUN	AT	0.7	0.7	0	0	E,B
WOODLEY	Woodley	SX41407445	05/07/93	3 RUN	AT	12.2	39.7	0	0	E

APPENDIX B

Key					
*	no cluster	D	daon	E	ed
A	absent	R	roach	B	bullhead
P	present	G	grayling	SL	stone loach
**	adipose fin-clipped fish recorded	ST	adult sea trout M		minnow
BTAFC	stocked trout adipose fin clip SS		adult salmon	L	brook lamprey
BTAFC(B3)	stocked trout - AFC - blue dye mark left pelvic fin				
BTAFC(BC)	stocked trout - AFC - blue dye mark on caudal peduncle				

Survey Types

- DIP** An electric fishing survey on a riffle area for 20 minutes without stop nets used to establish which species and agegroups are present.
- 3 RUN** A full semi-quantitative electric-fishing survey of a section of river enclosed by stop nets. Fish removals are carried out three times and the total population estimated from the numbers caught in each run.
- 1 RUN** A single run, using electric fishing, of a section enclosed by nets. Multiplication factors are used to give a population estimate.
- CLUSTER** Sites are grouped into one '3 run' site and several '1 run' sites according to geographical location and habitat characteristics. A multiplication index is calculated for each species and age group for each '3 run' site. This index is then applied to the single run site to give a population estimate.

Summary Results of River Lyd Electric-fishing Survey 1993 (Roadford Investigations)

RIVER	SITE	NGR	DATE	SURVEY TYPE	CLUSTER	TROUT 0+	TROUT =>1+	SALMO N 0+	SALMON =>1+	OTHER SPECIES	COMMENTS
LYD	Lydford Gorge	SX 492 839	23/07/93	1 RUN	A	2.1	20.5	21.4	2.6	E,B	
	Greenlance	SX 444 883	26/07/93	1 RUN	A	2.3	3.2	31.7	8.8	B,SL, L	
	Sydenham	SX 429 838	13/08/93	3 RUN	A	0.0	3.9	38.8	3.7	E,B,SL,M	
	Spry Farm	SX 406 852	16/08/93	1 RUN	A	0.0	1.3	34.0	10.3	B,SL,M	
	Lifton Playing Field	SX 392 850	20/08/93	1 RUN	A	0.0	3.3	33.9	16.3	E,B,SL, ST(308mm)	
	Lifton Park	SX 388 843	24/08/93	1 RUN	A	0.0	0.0	15.1	3.0	E,B,SL,M	
	US Gathedeley	SX 380 841	26/08/93	1 RUN	A	0.0	2.0	41.5	20.3	E,B,SL,M,GR(97mm)	
	D/S Gathedeley	SX 377 840	Not Surveyed								Engineering work
	Wixhill Bridge	SX 467 899	11/08/93	1 RUN	B	0.0	6.2	3.3	0.3	B,SL,M	
	Thrusdelton	SX 445 891	10/08/93	3 RUN	B	0.0	3.1	18.1	0.4	E,B,SL,M	
THRUSHEL	Townleigh	SX 426 872	06/08/93	1 RUN	B	1.3	3.9	16.3	0.3	E,B,SL,M	
	D/S Hayne Bridge	SX 416 866	18/08/93	3 RUN	C	0.0	7.0	1.3	2.6	E,B,SL,M,L	
	Tinhey	SX 402 857	19/08/93	1 RUN	C	0.3	1.0	19.4	2.2	E,B,SL,M,L	
	Tinhey Bridge	SX 395 855	17/08/93	1 RUN	C	0.2	0.6	44.6	2.5	E,B,SL, L	
	D/S Slew Wood	SX 417 894	27/08/93	1 RUN	D	0.0	1.6	0.0	*2.1	E,B,SL,M	BT AFC(B3) 213mm
	Rexon	SX 409 883	14/07/93	3 RUN	D	2.0	1.7	0.0	0.0	E,B,SL,M	BT AFC(BC) 206mm
WOLF	D/S Kellacott	SX 405 876	02/08/93	1 RUN	E	1.1	1.9	17.1	0.3	B,SL	BT AFC 205 mm
	Lower Cookworthy Farm	SX 402 870	03/08/93	1 RUN	E	0.0	1.6	0.0	1.4	E,B,SL	
	US Cookworthy Trap	SX 404 865	04/08/93	1 RUN	E	0.5	3.4	12.8	1.3	E,B,SL,M,L	BT AFC 242mm
	Cookworthy	SX 403 863	12/08/93	3 RUN	E	0.0	1.0	14.4	2.1	E,B,SL,M	
	Wolf Confluence	SX 402 862	11/08/93	1 RUN	E	0.4	0.9	17.1	2.7	E,B,SL,M,ST(333mm)	
	Kellacott Stream	SX 404 897	01/08/93	1 RUN	F	0.0	2.3	6.6	0.0	B,SL	
	Drewsmill	SX 406 876	01/08/93	3 RUN	F	0.0	2.0	3.4	0.0	B,SL	

APPENDIX B

Summary Results of Upper Tamar Alleviation of Low Flows Electric-fishing Survey 1993

RIVER	SITE	NGR	DATE	SURVEY TYPE	CLUSTER	POPULATION DENSITIES (No./100m2)				OTHER SPECIES
						TROUT 0+	TROUT >1+	SALMON 0+	SALMON >1+	
TAMAR	U/S Tamar Lakes	SS 281 135	03/06/93	3 RUN	*	0	9.0	0	0	B,SL, L
	Vinworthy	SS 298 103	04/06/93	DIP	*	P	A	A	A	E,B,SL,M
	Dexboer	SS 294 089	02/06/93	1 RUN	AA	0	1.1	0	0	E, SL,M
	Morton Mill	SS 284 086	04/06/93	DIP	*	A	F	F	A	E,B,SL,M,R
	Great Morton	SS 281 071	19/08/93	DIP	*	P	P	P	P	E,B,SL,M
	Tamastone	SS 283 054	04/06/93	3 RUN	AA	0	2.4	0	0.3	F,B,SL,M
	Bridgecude	SS 273 027	04/06/93	1 RUN	AA	0	0	0	0	B,SL,M
	Bradford Manor	SS 276 009	04/06/93	1 RUN	AA	0	0	0.6	0	B,SL,M
	Crowford Bridge	SX 287 994	07/06/93	2 RUN	*	0	0.8	0	0.8	B,SL,M,L,D
	D/S Crowford Br	SX 289 992	08/06/93	1 RUN	AB	0.3	2.9	0	0.4	E,B,SL,M
	Haydon	SX 297 988	02/07/93	3 RUN	AB	0	4.8	0	0	E,B,SL,M,L
	U/S Trepoyle Fm	SX 302 986	05/07/93	1 RUN	AB	0	3.9	13.5	0	B,SL,M,L
	D/S Trepoyle Fm	SX 306 980	05/07/93	1 RUN	AB	0	8.3	7.7	0	B,SL,M
	U/S N.Tamerton(A)	SX 316 975	07/06/93	1 RUN	AC	0	0.7	0.6	1.6	E,B,SL,M
	U/S N.Tamerton(B)	SX 316 975	07/06/93	1 RUN	AC	0	1.4	2.8	0	E,B,SL,M
	North Tamerton	SX 317 975	07/06/93	3 RUN	AC	0	3.2	1.7	1.4	E,B,SL,M,L
	D/S N.Tamerton(A)	SX 319 969	08/06/93	1 RUN	AC	0	0.8	4.3	0	B,SL,M
	D/S N.Tamerton(B)	SX 322 966	01/07/93	1 RUN	AC	0	0	3.9	0	B,SL,M
	Tamertown	SX 335 911	08/07/93	3 RUN	*	0	0.6	1.6	0	E,B,SL,M,G
	Dexboer	SS 294 089	31/08/93	3 RUN	*	0	0.9	1.8	0	E, SL,M
	Tamastone	SS 283 054	01/09/93	3 RUN	*	0	2.0	0.6	1.1	B,SL,M
	Bridgecude	SS 273 027	31/08/93	3 RUN	*	0	0.6	0	0.6	B,SL,M
	Bradford Manor	SS 276 009	07/09/93	3 RUN	*	0	0.4	0.4	0	B,SL,M
	Crowford Bridge	SX 287 994	06/09/93	3 RUN	AD	0	1.4	0.5	0	E,B,SL,M,L
	D/S Crowford Br	SX 289 992	06/09/93	1 RUN	AD	1.2	0.5	0	0.4	B,SL,M,D
	Haydon	SX 297 988	06/09/93	1 RUN	AD	0.4	1.1	2.2	0	B,SL,M
	U/S Trepoyle Fm	SX 302 986	07/09/93	1 RUN	AD	0.3	2.3	8.6	0	B,SL,M,L
	D/S Trepoyle Fm	SX 306 980	07/09/93	1 RUN	AD	0	3.1	5.2	0.9	B,SL,M
	U/S N.Tamerton(A)	SX 316 975	02/09/93	1 RUN	AE	0.4	0	3.6	1.5	B,SL,M,G
	U/S N.Tamerton(B)	SX 316 975	02/09/93	1 RUN	AE	0	0	4.8	0	E,B,SL,M,G
	North Tamerton	SX 317 975	01/09/93	3 RUN	AE	0	5.1	1.0	1.6	B,SL,M
	D/S N.Tamerton(A)	SX 319 969	02/09/93	1 RUN	AE	0	0	1.5	0	B,SL,M,G
	D/S N.Tamerton(B)	SX 322 966	02/09/93	1 RUN	AE	0	1.5	10.3	0	B,SL,M

APPENDIX B

ROD CATCH RETURNS 1954-1993

ROD CATCHES Year	Salmon	Sea Trout
1954	830	179
1955	279	138
1956	559	134
1957	506	140
1958	641	156
1959	242	193
1960	407	188
1961	163	276
1962	279	213
1963	477	339
1964	306	345
1965	584	407
1966	691	353
1967	701	381
1968	450	560
1969	679	744
1970	829	634
1971	701	404
1972	671	465
1973	921	665
1974	960	451
1975	1092	538
1976	266	280
1977	453	358
1978	401	418
1979	491	831
1980	1169	352
1981	1109	1105
1982	292	777
1983	357	724
1984	373	336
1985	814	362
1986	893	320
1987	478	843
1988	787	597
1989	344	276
1990	307	137
1991	266	183
1992	360	294
1993	428	281

APPENDIX C WATER QUALITY TABLES

TABLE C1 : STANDARDS FOR THE FIVE RIVER ECOSYSTEM USE CLASSES

Use Class	DO % sat 10%ile	BOD (ATU) mg/l 90%ile	Total Ammonia mgN/l 95%ile	Un-ionised Ammonia mgN/l 95%ile	pH 5%ile & 95%ile	Hardness mg/l CaCO ₃	Dissolved Copper µg/l 95%ile	Total Zinc µg/l 95%ile	Class Description
1	80	2.5	0.25	0.021	6.0 - 9.0	≤10 >10 and ≤50 >50 and ≤100 >100	5 22 40 112	30 200 300 500	Water of very good quality suitable for all fish species
2	70	4.0	0.6	0.021	6.0 - 9.0	≤10 >10 and ≤50 >50 and ≤100 >100	5 22 40 112	30 200 300 500	Water of good quality suitable for all fish species
3	60	6.0	1.3	0.021	6.0 - 9.0	≤10 >10 and ≤50 >50 and ≤100 >100	5 22 40 112	300 700 1000 2000	Water of fair quality suitable for high class coarse fish populations
4	50	8.0	2.5	-	6.0 - 9.0	≤10 >10 and ≤50 >50 and ≤100 >100	5 22 40 112	300 700 1000 2000	Water of fair quality suitable for coarse fish populations
5	20	15.0	9.0	-	-	-	-	-	Water of poor quality which is likely to limit coarse fish populations

APPENDIX C

TABLE C2: EC DIRECTIVE ON THE QUALITY OF FRESHWATERS NEEDING PROTECTING OR IMPROVEMENT IN ORDER TO SUPPORT FISH LIFE (78/659/EEC)

DETERMINAND	SALMONID WATERS		CYPRINID WATERS	
	'G'	'T'	'G'	'T'
Dissolved Oxygen as mg/l O ₂ ^a	100% > 7	50% > 9	100% > 5	50% > 7
pH as pH units	-	6.0-9.0	-	6.0-9.0
Suspended Solids at mg/l ^b	25	-	25	-
BOD (Total) as mg/l O ₂	5	-	8	-
Nitrite as mg/l N	0.150	-	0.460	-
Non-ionised Ammonia as mg/l N	0.004	0.021	0.004	0.021
Ammonia (Total) as mg/l N	0.030	0.780	0.160	0.780
Total Residual Chlorine as mg/l HOCl	-	0.005	-	0.005
Zinc (Total) as mg/l Zn				
Water Hardness 0-50	-	0.03	-	0.30
(mg/l CaCO ₃) 50-100	-	0.20	-	0.70
100-250	-	0.30	-	1.00
>250	-	0.50	-	2.00
Copper (Dissolved) as mg/l Cu				
Water Hardness 0-50	0.005	-	0.005	-
(mg/l CaCO ₃) 50-100	0.022	-	0.022	-
100-250	0.040	-	0.040	-
>250	0.112	-	0.112	-
^a For dissolved oxygen, 50% median and 100% minimum standard. ^b For suspended solids, the 'G' value is an annual average concentration.				
For application of these standards, reference <u>must</u> be made to Article 6 and the Annexes of the Directive, and the appropriate DoE Implementation Guidelines.				

APPENDIX C

TABLE C3: EC DANGEROUS SUBSTANCES DIRECTIVE ON POLLUTION CAUSED BY CERTAIN SUBSTANCES DISCHARGED IN THE AQUATIC ENVIRONMENT OF THE COMMUNITY, (76/464/EC)

EQSs FOR LIST I SUBSTANCES (INLAND WATERS)

Parameter	Units	Value	Status (1)
Mercury	µg Hg/l	1.0	AA,T
Cadmium (2)	µg Cd/l	5.0 1.0	AA,T AA,T,B (4)
Hexachlorocyclohexane (HCH) (2)	µg/l	0.1 0.05	AA,T AA,T,B (4)
Tetrachloromethane (CTC)	µg/l	12	AA,T
DDT (para-para DDT isomer) (2)	µg/l	0.01	AA,T
Total DDT (2)	µg/l	0.025	AA,T
Pentachlorophenol (PCP) (2)	µg/l	2	AA,T
'The Drins' (from 1 Jan 1989)	µg/l	0.03 (3)	AA,T
Aldrin (from 1 Jan 1994)	µg/l	0.01	AA,T
Dieldrin (from 1 Jan 1994)	µg/l	0.01	AA,T
Endrin (from 1 Jan 1994)	µg/l	0.005	AA,T
Isodrin (from 1 Jan 1994)	µg/l	0.005	AA,T
Hexachlorobenzene (HCB) (2)	µg/l	0.03	AA,T
Hexachlorobutadiene (HCBd) (2)	µg/l	0.1	AA,T
Chloroform	µg/l	12	AA,T
1,2-dichloroethane	µg/l	10	AA,T
Trichloroethylene	µg/l	10	AA,T
Perchloroethylene	µg/l	10	AA,T
Trichlorobenzene(TCB)	µg/l	0.4	AA,T

Proposals have been published for the following List I substances but these have not, so far, been adopted:

Trifluralin, endosulphan, simazine, triorganotin compounds (tributyltin oxide, triphenyltin acetate, triphenyltin oxide, triphenyltin hydroxide), atrazine, organophosphorus substances (azinphos-methyl, azinphos-ethyl, fenitrothion, fenthion, malathion, parathion and parathion-methyl, dichlorvos).

- Notes: (1) AA=Annual Average, T=Total, B=Background Monitoring
 (2) A 'standstill' provision exists for concentrations in sediments and/or shellfish and/or fish
 (3) Maximum of 0.005 for Endrin
 (4) B=Background Monitoring: only applies at designated end of catchment sites

APPENDIX C

EQSs FOR LIST II SUBSTANCES (INLAND WATERS) (1)

Table 3 continued

Parameter	Units	Value (3)		Hardness (mg CaCO ₃ /l)	Status (2)
		A Std	B Std		
Lead	µg Pb/l	4 10 10 20 20 20	50 125 125 250 250 250	0 to 50 50 to 100 100 to 150 150 to 200 200 to 250 >250	AA,D
Chromium	µg Cr/l	5 10 20 20 50 50	150 175 200 200 250 250	0 to 50 50 to 100 100 to 150 150 to 200 200 to 250 >250	AA,D
Zinc	µg Zn/l	8 50 75 75 75 125	75 175 250 250 250 500	0 to 50 50 to 100 100 to 150 150 to 200 200 to 250 >250	AA,T
Copper	µg Cu/l	1 6 10 10 10 28	1 6 10 10 10 28	0 to 50 50 to 100 100 to 150 150 to 200 200 to 250 >250	AA,D
Nickel	µg Ni/l	50 100 150 150 200 200	50 100 150 150 200 200	0 to 50 50 to 100 100 to 150 150 to 200 200 to 250 >250	AA,D
Arsenic	µg As/l	50		All	AA,D
Boron	µg B/l	2000		All	AA,T
Iron	µg Fe/l	1000		All	AA,D
pH	pH values	6 to 9		All	95% of samples
Vanadium	µg V/l	20 60	20 60	0 to 200 200+	AA,T
Tributyltin	µg/l	0.02		All	M,T
Triphenyltin	µg/l	0.02		All	M,T
Polychlorochloromethyl-sulphonamidodiphenyl ether (PCSDs)	µg/l	0.05		All	T, 95% of samples
Sulcofuron	µg/l	25		All	T, 95% of samples
Flucofuron	µg/l	1.0		All	T, 95% of samples
Permethrin	µg/l	0.01		All	T, 95% of samples
Cyfluthrin	µg/l	0.001		All	T, 95% of samples

Notes:

- (1) National environmental quality standards recommended for the UK.
- (2) AA=Annual Average; D=Dissolved; T=Total; M=Maximum Allowable Concentration
- (3) A Std denotes standards for the protection of sensitive aquatic life
B Std denotes standards for the protection of other aquatic life

APPENDIX C

TABLE C4: EC DIRECTIVE CONCERNING THE QUALITY REQUIRED OF SURFACE WATER INTENDED FOR THE ABSTRACTION OF DRINKING WATER IN THE MEMBER STATES (75/440/EEC)

Definition of the Standard Methods of Treatment for Transforming Surface Water of Categories A1, A2 and A3 into Drinking Water

Category A1

Simple physical treatment and disinfection, eg rapid filtration and disinfection.

Category A2

Normal physical treatment, chemical treatment and disinfection, eg pre-chlorination, coagulation, flocculation, decantation, filtration, disinfection (final chlorination).

Category A3

Intensive physical and chemical treatment, extended treatment and disinfection, eg chlorination to break-point, coagulation, flocculation, decantation, filtration, absorption (activated carbon), disinfection (ozone, final chlorination).

I	=	mandatory
G	=	guide
O	=	exceptional climatic or geographical conditions

Table C4 Continued

CHARACTERISTICS OF SURFACE WATER INTENDED FOR THE ABSTRACTION OF DRINKING WATER			CATEGORIES					
			A1		A2		A3	
			G	I	G	I	G	I
PARAMETERS								
1	pH		6.5 to 8.5	-	5.5 to 9	-	5.5 to 9	-
2	Coloration (after simple filtration)	mg/l Pt scale	10	20 (0)	50	100 (0)	50	200 (0)
3	Total suspended solids	mg/l SS	25	-	-	-	-	-
4	Temperature	°C	22	25 (0)	22	25 (0)	22	25 (0)
5	Conductivity	µs/cm ¹ at 20°C	1000	-	1000	-	1000	-
6	Odour	(dilution factor at 25°C)	3	-	10	-	20	-
7	Nitrates	mg/l NO ₃	25	50 (0)	-	50 (0)	-	50 (0)
8	Fluorides	mg/l F	0.7 to 1	1.5	0.7 to 1.7	-	0.7 to 1.7	-
9	Total extractable organic chlorine	mg/l Cl	-	-	-	-	-	-
10	Dissolved Iron	mg/l Fe	0.1	0.3	1	2	1	-
11	Manganese	mg/l Mn	0.05	-	0.1	-	1	-
12	Copper	mg/l Cu	0.02	0.05 (0)	0.05	-	1	-
13	Zinc	mg/l Zn	0.5	3	1	5	1	5
14	Boron	mg/l B	1	-	1	-	1	-
15	Beryllium	mg/l Be	-	-	-	-	-	-
16	Cobalt	mg/l Co	-	-	-	-	-	-
17	Nickel	mg/l Ni	-	-	-	-	-	-
18	Vanadium	mg/l V	-	-	-	-	-	-
19	Arsenic	mg/l As	0.01	0.05	-	0.05	0.05	0.1
20	Cadmium	mg/l Cd	0.001	0.005	0.001	0.005	0.001	0.005
21	Total Chromium	mg/l Cr	-	0.05	-	0.05	-	0.05
22	Lead	mg/l Pb	-	0.05	-	0.05	-	0.05
23	Selenium	mg/l Se	-	0.01	-	0.01	-	0.01
24	Mercury	mg/l Hg	0.0005	0.001	0.0005	0.001	0.0005	0.001

Table C4 Continued

CHARACTERISTICS OF SURFACE WATER INTENDED FOR THE ABSTRACTION OF DRINKING WATER			CATEGORIES					
			A1		A2		A3	
			G	I	G	I	G	I
PARAMETERS								
25	Barium	mg/l Ba	-	0.1	-	1	-	1
26	Cyanide	mg/l Cn	-	0.05	-	0.05	-	0.05
27	Sulphates	mg/l SO ₄	150	250	150	250 (0)	150	250 (0)
28	Chlorides	mg/l Cl	200	-	200	-	200	-
29	Surfactants (reacting with methyl blue)	mg/l (laurylsulphate)	0.2	-	0.2	-	0.5	-
30	Phosphates	mg/l P ₂ O ₅	0.4	-	0.7	-	0.7	-
31	Phenols (phenol index) paramitraniline 4 aminopyrine	mg/l C ₆ H ₅ OH	-	0.001	0.001	0.005	0.01	0.1
32	Dissolved or emulsified hydrocarbons (after extraction by petroleum ether)	mg/l	-	0.05	-	0.2	0.5	1
33	Polycyclic aromatic hydrocarbons	mg/l	-	0.0002	-	0.0002	-	0.001
34	Total pesticides (parathion, BHC, dieldrin)	mg/l	-	0.001	-	0.0025	-	0.005
35	Chemical oxygen demand (COD)	mg/l O ₂	-	-	-	-	30	-
36	Dissolved oxygen saturation rate	% O ₂	> 70	-	> 50	-	> 30	-
37	Biochemical oxygen demand (BOD ₅) (at 20°C with nitrification)	mg/l O ₂	< 3	-	< 5	-	< 7	-
38	Nitrogen by Kjeldahl method (except NO ₃)	mg/l N	1	-	2	-	3	-
39	Ammonia	mg/l NH ₄	0.05	-	1	1.5	2	4 (0)
40	Substances extractable with chloroform	mg/l SEC	0.1	-	0.2	-	0.5	-
41	Total organic carbon	mg/l C	-	-	-	-	-	-
42	Residual organic carbon after flocculation and membrane filtrations (5 µ) TOC	mg/l C	-	-	-	-	-	-
43	Total coliforms 37°C	/100 ml	50	-	5000	-	50000	-

Table C4 Continued

CHARACTERISTICS OF SURFACE WATER INTENDED FOR THE ABSTRACTION OF DRINKING WATER			CATEGORIES					
			A1		A2		A3	
			G	I	G	I	G	I
PARAMETERS								
44	Faecal coliforms	/100 ml	20	-	2000	-	20000	-
45	Faecal streptococci	/100 ml	20	-	1000	-	10000	-
46	Salmonella		Not present in 5000 ml	-	Not present in 1000 ml	-	-	-

TABLE C5: 3RD NORTH SEA CONFERENCE - PRIORITY HAZARDOUS SUBSTANCES (ANNEX 1A LIST OF SUBSTANCES)

Mercury	Simazine
Cadmium	Atrazine
Copper	Triorganotin compounds
Zinc	Azinphos-ethyl
Lead	Azinphos-methyl
Arsenic	Fenitrothion
Chromium	Fenthion
Nickel	Malathion
Aldrin	Parathion
Dieldrin	Parathion-methyl
Endrin	Dichlorvos
Isodrin	Trichloroethylene
HCH	Tetrachloroethylene
DDT	1,1,1-trichloroethane
Pentachlorophenol	Trichlorobenzene
Hexachlorobenzene	1,2-dichloroethane
Hexachlorobutadiene	Polychlorinated biphenyls
Carbon tetrachloride	Dioxins (*)
Chloroform	
Endosulphan	
Trifluralin	

At the 3rd North Sea Conference, the UK Government undertook to reduce loadings (flow x concentration) of the 'Annex 1A' list of substances except dioxins (*) entering UK tidal waters from rivers and direct discharges by 50% (70% for Hg, Cd, Pb) by 1995, against a 1985 baseline.

APPENDIX D

BIOLOGICAL SURVEY SUMMARIES SUMMER 1994

Nine biological monitoring points were sampled on the Lower Tamar and tributaries.

NRA 06 1214 RIVER TAMAR - GREYSTONE BRIDGE (SX 3683 8025)

Despite variation in BMWP scores at this site a fairly consistent ASPT suggests continuing good water quality. ASPT score eliminates variation due to high flow rates which can affect sampling at this location.

NRA 06 1215 RIVER TAMAR - HORSEBRIDGE (SX 4001 7482)

The Summer 1994 scores were good and indicative of excellent water quality. A diverse range of pollution - sensitive taxa were present at this site. The scores are generally consistent with previous years sampling results.

NRA 06 1218 DAMERAL STREAM - PRIOR TO RIVER TAMAR (SX 3988 7549)

The scores recorded at this site in the Summer 1994 are consistent with previous years scores and reflect continuing good water quality.

NRA 06 1290 LOWLEY BROOK - LANDLAKE BRIDGE (SX 3288 8237)

The BMWP and ASPT results obtained in the Summer 1994 are indicative of reasonable water quality. The presence of the moss *Amblystegium riparium* and the limited number of Group (1) taxa may indicate mild, chronic organic enrichment. The scores are however consistent with those of previous sampling years.

NRA 06 1219 LOWLEY BROOK - LOWLEY BRIDGE (SX 3589 7878)

The Summer 1994 results are consistent with previous years scores and reflect good water quality.

NRA 06 1292 LUCKETT - OLD MILL (SX 3697 7386)

The results from the Summer 1994 sampling represented good water quality. The scores were slightly lower than previous years although group (1) pollution tolerant taxa were well represented.

NRA 06 1220 LUCKETT - LUCKETT BRIDGE (SX 3882 7367)

Scores obtained at this site were indicative of poor water quality. The high ASPT value coupled to the low BMWP score and presence of ochre is suggestive of metalliferous contamination. The scores on a year to year basis are very consistent which is indicative of a stabilised invertebrate community and a chronic pollution problem.

NRA 06 1217 LATCHLEY BROOK - LATCHLEY (SX 4090 7368)

The BMWP and ASPT scores obtained at this site in the Summer 1994 are indicative of poor water quality. This trend is generally consistent with previous years results. The absence of organic sensitive taxa and the proliferation of organic tolerant Mayfly and Blackfly larvae indicates the presence of organic enrichment.

NRA 06 1289 PORTONTOWN STREAM - PRIOR TO RIVER TAMAR WEIR (SX 4143 7374)

The BMWP and ASPT scores recorded from this site were the lowest obtained for the last 3 sampling years and indicative of poor water quality. The absence of organic sensitive taxa tends to suggest organic enrichment. An abundance of organic sensitive taxa were present in the Spring 1994 when the biological quality was representative of good water quality.

SUMMARY

The biological monitoring points sampled within the 12E catchment were generally of good/reasonable water quality. Possible organic enrichment problems were highlighted at NRA 06 1290 Lowley Brook Landlake Bridge, NRA 06 1217 Latchley Brook Latchley and NRA 06 1289 Portontown Stream Prior to River Tamar Weir. There would appear to be a problem with chronic sources of metalliferous mine waste contamination at NRA 06 1220 Lockett, Lockett Bridge, due to past mining activity.

Five sites were sampled on the River Lyd and its tributaries.

RIVER LEW

NR 06 1226 LEW - COMBEBOW BRIDGE

Here, the BMWP score in Summer 1994 was exactly the same as Summer 1990 and considerably higher than Summer 1992. The ASPT score was also high, indicating good water quality. Scores have not reached over 200 since Autumn 1990 and Spring 1992 but 1994 results do show a marked recovery from the low scores found throughout the rest of 1992. An increased silt covering over the substrate was noted this Summer suggesting the possibility of roadworks or building works upstream but this appeared to be having no detrimental effect upon the invertebrate community.

NR 06 1225 LEW - PRIOR TO RIVER LYD

This site showed higher BMWP scores than previous Summer samples. An ASPT of over 6.0 reflected good water quality. There was a general covering of algae over most of the site and small amounts of foam present at the time of sampling. The animal access to the site may account for this slight organic enrichment but, again, this did not appear to have affected the invertebrate adversely.

RIVER LYD AND QUITHER BROOK

The main River Lyd was sampled above and below the confluence with the Quither Brook.

NR 06 1224 QUITHER BROOK - PRIOR TO RIVER LYD

The BMWP score found here in Summer 1994 compares well with previous Summer surveys in 1990 and 1992. There was a large covering of algae noted at the site, suggesting slight organic enrichment, but the ASPT of 6.04 did not indicate a significant effect upon the invertebrate population.

NR 06 1294 LYD - SYDENHAM BRIDGE

This site is above the confluence with Quither Brook. The BMWP score is similar to that found in previous Summer surveys and the high ASPT score of 6.28 was indicative of good water quality.

NR 06 1223 LYD - LIFTON BRIDGE

This site is below the confluence with Quither Brook. The BMWP score was higher this Summer than in Summer 1990 and 1992 and the ASPT was also high (6.24). Pollution incidents in the past have affected this site but the results found this Summer indicate that a good recovery has been made.

SUMMARY

The results of the biological survey of this catchment in Summer 1994 were representative of good water quality throughout.

Nine sites were sampled on the River Wolf, Thrushel and tributaries.

RIVER WOLF

Five sites were sampled in this sub-catchment in Summer 1994.

NR 06 5246 WOLF - SOUTHWEEK FOOTBRIDGE

This site was the highest point sampled on the River Wolf, prior to Roadford Reservoir. This was a new site, first sampled in Spring 1994, therefore no comparisons can be drawn with previous data. The BMWP and ASPT scores for this year did, though, generally reflect good water quality.

NR 06 5242 HENNARD STREAM - PRIOR TO ROADFORD RESERVOIR

The biological scores here showed an improvement compared to Summer records for 1992 and reflected a diverse invertebrate community.

NR 06 1298 WOLF - ROADFORD NEW BRIDGE

This site is below Roadford Reservoir. The BMWP score reflected a significant improvement compared to very poor results in Summer 1992. Both samples taken in 1994 indicated good water quality at this site.

NR 06 1235 BROADWOOD BROOK - KELLACOTT BRIDGE

The BMWP score here was the highest Summer value in the three years it has been sampled, illustrating a wide diversity of invertebrates.

NR 06 1234 WOLF - PRIOR TO THRUSHEL

Biological results again showed water quality to be good.

RIVER THRUSHEL

This sub-catchment contains four sites which were sampled in Summer 1994.

NR 06 1228 THRUSHEL - RIVERMEAD BRIDGE

This was the highest point at which the River Thrushel was sampled. The BMWP score was lower than Summer 1992 but exactly the same as that found in Summer 1990. The results for 1994 generally appear more similar to those for 1990 than 1992 but no specific reasons for this were obvious. A reasonable water quality was still, however, indicated.

NR 06 1231 BRATTON BROOK - BRATTON CLOVELLY

This site is about 2km above the confluence of Bratton Brook with the River Thrushel. Results here reflected good water quality.

NR 06 1232 BREAZLE WATER - PRIOR TO RIVER THRUSHEL

The BMWP score in Summer 1994 was a little lower than Summer results in 1990 and 1992. This may have been due to the very low, slow flow reducing the diversity of habitats available to the invertebrate community.

NR 06 1230 THRUSHEL - TINHAY BRIDGE

This was the furthest downstream site sampled on the River Thrushel, where the biological results illustrated consistently good water quality.

SUMMARY

The invertebrate data for both sub-catchments was indicative of good water quality throughout the catchment as a whole. Breazle Water and the River Thrushel at Rivermead Bridge did, though, appear to fall slightly below this standard.

Three sites were sampled in the River Carey Catchment.

NRA 06 5202 CAREY - PANSON (SX 3715 9258)

A high Summer 1994 BMWP score and a diverse and well balanced macroinvertebrate community reflects continued excellent water quality at this site.

NRA 06 1237 CAREY - HEALE BRIDGE (SX 3589 8617)

The Summer 1994 BMWP score, although lower than the high score recorded in the Summer of 1992, continued to reflect good water quality at this site. Mild, localised organic enrichment due to cattle access may be responsible for the varying BMWP scores.

NRA 06 5201 CAREY - HALWILL BRIDGE - QUODITCH (SX 4207 9851)

The Summer 1994 BMWP score was the highest score recorded since 1991 indicating excellent water quality at this site.

SUMMARY

Summer 1994 scores are generally consistent with scores obtained in previous years, reflecting good water quality. At Heale Bridge (1237), variations in BMWP score since 1990 may suggest that there may be a mild, localised organic enrichment problem.

Five biological monitoring points were sampled in the Upper Tamar.

NRA 06 5204 RIVER TAMAR - BOYTON BRIDGE (SX 3288 9230)

The Summer 1994 scores represented a slight improvement in water quality compared to previous years data, and were indicative of excellent water quality.

NRA 06 5205 RIVER TAMAR - DRUXTON BRIDGE (SX 3443 8830)

The BMWP and ASPT scores obtained in the Summer 1994 reflected good water quality. This is consistent with the Spring 1994 and Summer 1991 results

but represents an improvement in quality compared to the 1992 survey results.

NRA 06 1239 RIVER TAMAR - NETHER BRIDGE (SX 3497 8662)

The scores obtained in the Summer 1994 represent good water quality. There has been a slight deterioration in quality observed at this site since June 1992. This is a reflection of the loss of some organic intolerant taxa which may indicate mild organic enrichment.

NRA 06 5206 RIVER TAMAR - POLSON BRIDGE (SX 3556 8492)

The Summer 1994 BMWP and ASPT scores were indicative of reasonable water quality although reflecting a significant deterioration in quality compared to Spring 1994. The loss of organic sensitive taxa from the macroinvertebrate community is indicative of organic enrichment. The results from the Spring and Autumn 1992 represent a similar situation.

NRA 06 1240 TALA WATER - BRIDGETOWN (SX 3410 8913)

The BMWP and ASPT scores obtained for this site was indicative of reasonable water quality. Summer 1994 was the lowest score obtained at this site over the last 3 years. The loss of organic tolerant taxa from this site tends to indicate organic enrichment.

SUMMARY

The main River Tamar within the 12J catchment is generally of good/reasonable water quality. The Summer 1994 results indicated potential organic enrichment problems at NRA 06 1239 Nether Bridge, NRA 06 5206 Polson Bridge. The reduction in biological quality observed at NRA 06 1240 at Bridgetown on the Tala Water may also be indicative of mild organic enrichment.

Seven sites were sampled on the Rivers Claw and Deer.

NRA 06 1244 RIVER DEER - RYDON BRIDGE (SS 3354 0413)

The Summer 1994 BMWP score was consistent with the score obtained in the Summer of 1992 reflecting good water quality. However, scores obtained during 1992 and 1994 were considerably lower than those obtained in 1990.

NRA 06 5209 DEER - DEER BRIDGE (SX 3192 4734)

The slight deterioration in BMWP scores has been noted at Deer Bridge since the Spring of 1991. The Summer 1994 score was similar to the score recorded in the Summer of 1992 reflecting good water quality.

NRA 06 1245 DEER - WINSOTT BRIDGE (SS 3385 0144)

Scores recorded at this site, although indicative of good water quality, have gradually deteriorated since the Summer of 1992.

NRA 06 5208 CLAW - CLAWTON BRIDGE (SX 3536 9933)

The Summer 1994 BMWP score continues to reflect good water quality at this site.

NRA 06 1242 CLAW - TETCOTT BRIDGE (SX 3279 9696)

The Summer 1994 score was consistent with previous Summer scores reflecting good water quality. A decline in Group 1 taxa sensitive to organic pollution may suggest an organic enrichment problem in the Summer and Autumn seasons.

NRA 06 1246 COLESMILL STREAM - 100M DOWNSTREAM OF HOLSWORTHY STW (SS 3387 0316)

The Summer 1994 score reflects continued good water quality at this site.

NRA 06 5210 DUNSTAPLE BROOK - UPSTREAM COLESMILL CONFLUENCE (SS 3452 0352)

The Summer 1994 BMWP score reflected good water quality at this site. Lower BMWP scores recorded in all Summer and Autumn seasons since 1991 suggests a seasonal organic enrichment problem.

SUMMARY

Summer 1994 scores recorded at both River Claw sites were generally consistent with previous years' data. A decline in organic-sensitive taxa in the Summer and Autumn seasons at Tetcott Bridge (1242) may suggest an organic enrichment problem. Summer 1994 BMWP scores recorded at three sites on the River Deer have reflected good water quality.

Twelve sites were sampled in the Upper Tamar, Derrill Water and Lamberal Water.

NRA 06 1247 TAMAR - DEXBEER BRIDGE (SS 2957 0894)

The summer 1994 BMWP score recorded at Dexbeer Bridge was consistent with previous Summer scores reflecting very good biological water quality.

NRA 06 5211 TAMAR - BUSES BRIDGE (SS 2809 1345)

The Summer 1994 BMWP score recorded at Buses Bridge was consistent with previous Summer scores indicating good water quality.

NRA 06 5215 TAMAR - CROWFORD BRIDGE (SX 2872 9943)

A deterioration in water quality was identified in the Summer of 1994 at Crawford Bridge when compared with the Spring 1994 result. A reduction in Group 1 taxa intolerant to organic enrichment indicated a chronic organic enrichment problem at this site. A similar deterioration score was noted in the Summer and Autumn of 1992.

NRA 06 5216 TAMAR - DOWNSTREAM CONFLUENCE WITH RIVER DEER (SX 3190 9726)

The high Summer 1994 BMWP score reflects excellent biological water quality at this site. An improvement in water quality was noted when comparisons were drawn with previous Summer scores.

NRA 06 1249 TAMAR - TAMERTON BRIDGE (SX 3179 9739)

The Summer 1994 score was consistent with scores recorded in previous years indicating very good water quality at this site.

NRA 06 1248 TAMAR - TAMARSTONE BRIDGE (SX 2832 0559)

The Summer 1994 score was the highest recorded since 1991 reflecting very good water quality.

NRA 06 5212 TAMAR - DOWNSTREAM LOWER TAMAR LAKE (SS 2955 1070)

The BMWP scores obtained downstream of Lower Tamar Lake have varied considerably since recording began in the Spring of 1991. The Summer 1994 score reflects good water quality at this site. The high percentage cover of emergent macrophytes, a silty substrate and a high water temperature may account for a higher BMWP score in the Summer of 1994. Substrate composition, compensation flow from the lake, water temperature and macrophyte cover are all varying factors that may contribute to inconsistent BMWP scores at this site.

NRA 06 5213 TAMAR - MORETON MILL (SS 2833 0850)

The Summer 1994 BMWP score obtained at Moreton Mill, although consistent with the Summer 1991 score, has shown a significant improvement in water quality when compared to the results obtained in the Summer and Autumn of 1992. The Summer 1994 score indicates good water quality at this site.

NRA 06 1250 LAMBERAL WATER - MORETON POUND BRIDGE (SS 2757 0894)

The Summer 1994 BMWP score was consistent with previous summer scores reflecting good water quality at this site.

NRA 06 1253 SMALL BROOK - HEADON BRIDGE (SS 3101 0730)

The Summer 1994 BMWP score obtained at the top of the Small Brook tributary at Headon Bridge indicated reasonable water quality. The Summer 1994 score was the highest Summer score recorded since 1990. Low scores recorded in previous Summers suggest that there was an annual organics problem at this site.

NRA 06 1254 SMALL BROOK - YOULDON BRIDGE (SS 2997 0530)

A relatively low BMWP score was recorded at Youldon Bridge in the Summer of 1994 reflecting reasonable water quality.

NRA 06 5245 DERRIL WATER - UPSTREAM DUALSTONE BRIDGE (SS 3013 0059)

The BMWP score obtained upstream of Dualstone Bridge in the Summer of 1994 was the highest Summer Score recorded since 1990 reflecting good water quality at this site.

SUMMARY

In general, Summer 1994 BMWP scores indicate that the River Tamar continues to be of good water quality. A deterioration in water quality resulting from a reduction in Group 1 taxa intolerant to organic pollution was identified at Crawford Bridge (5215). Substrate composition, compensation flow from the lake, water temperature and macrophyte cover are varying factors that may contribute to inconsistent BMWP scores recorded downstream of Lower Tamar Lake.

Although an organics problem has been evident at both sites on the Small Brook in previous years, the Summer 1994 BMWP scores indicate reasonable water quality at these sites.

Five biological monitoring sites were sampled on the River Ottery and Caudworthy Water.

NRA 06 5218 OTTERY - OTTERHAM MILL (SX 1742 9087)

The Summer 1994 BMWP scores was the highest Summer score recorded since 1991. Good water quality at this site was reflected by the presence of many Group 1 taxa sensitive to organic pollution.

NRA 06 5219 OTTERY - TRENGUNE BRIDGE (SX 1885 9329)

The BMWP score obtained in the Summer of 1994 was the lowest recorded to dated. The Summer 1994 BMWP score was similar to the low score obtained in the Autumn of 1992 reflecting reasonable water quality. A deterioration in BMWP score in the Autumn of 1992 and the Summer of 1994 has resulted from a reduction in Group 1 taxa intolerant to organic enrichment.

NRA 06 5220 OTTERY - YEOLMBRIDGE (SX 3178 8737)

A significant deterioration in water quality was reflected by a low Summer 1994 BMWP score. The Summer 1994 score was the lowest recorded since the Spring of 1991. This unusually low score can be attributed to a decline in taxa intolerant to organic enrichment.

NRA 06 1256 OTTERY - HELLESCOTT BRIDGE (SX 2844 8782)

The Summer 1994 BMWP score was the lowest recorded since the Spring of 1990. Although the Summer 1994 score was similar to the score obtained in the Autumn of 1992 it compared very poorly with previous Spring and Summer results. A decline in organic intolerant taxa suggest an organics problem at this site.

NRA 06 1259 CAUDWORTHY WATER - PRIOR TO RIVER OTTERY (SX 2672 8890)

The Summer 1994 BMWP score and the macroinvertebrate community at this site continues to reflect good water quality. A lower BMWP score and a decline in the number of Group 1 taxa suggest that there was a mild organic enrichment problem in the Autumn of 1992.

SUMMARY

The Summer BMWP scores recorded for the River Ottery at Trengune Bridge, Yeolmbridge and Hellescott Bridge have shown a deterioration in water quality. A decline in the numbers of taxa intolerant to organic enrichment explains these low scores. The River Ottery at Otterham Mill and Caudworthy Water, prior to the River Ottery continue to be of good water quality.

Two sites were sampled on the River Kensey.

NR 06 1261 KENSEY - TRUSCOTT BRIDGE

This site produced a higher BMWP score in Summer 1994 than Summer 1990 or 1992. A high ASPT score also indicated good water quality.

NR 06 1262 KENSEY - ST LEONARD'S BRIDGE

This site is just above the confluence of the River Kensey with the River Tamar. Scores here were also good, although the presence of sanitary waste in Spring 1994 does suggest that the site may be influenced intermittently by storm sewage overflow.

SUMMARY

Results for these two sites showed the water quality to be good in Summer 1994, although since records were first made in 1990 the quality has varied between reasonable and good.

Six biological monitoring points were sampled in the River Inny catchment.

NRA 06 5227 RIVER INNY - UPSTREAM DAVIDSTOW CREAMERY (SX 1534 8704)

The Summer 1994 BMWP and ASPT scores were indicative of poor biological quality. This site has undergone a severe deterioration in water quality since the Autumn 1992. This reduction is reflected by the loss of organic tolerant taxa which were prevalent in both 1991 and early 1992. In the Summer 1994 an organic smell was detected by the sampling officer. This site would appear to be subject to long term organic pollution.

NRA 06 5228 RIVER INNY - TREWINNOW BRIDGE (SX 1704 8647)

This site is situated downstream of Davidstow Creamery discharge point and obtained BMWP and ASPT scores that were indicative of reasonable/good water quality in the Summer 1994. The biological quality of this site is consistent with that observed in previous years.

NRA 06 5230 RIVER INNY - TWO BRIDGES (SX 2700 8180)

The Summer 1994 biological quality results recorded continuing very good water quality. This represents a considerable improvement on the Summer 1992 scores but is otherwise consistent with previous years.

NRA 06 1264 RIVER INNY - TRECAREL BRIDGE (SX 3217 7710)

The BMWP and ASPT scores obtained for the Summer 1994 were indicative of very good water quality. As was found at NRA 06 12130 Two Bridges, the Summer 1994 represented an improvement in quality compared to the Summer 1993. It is however consistent with the very high quality recorded prior to Summer 1992.

NRA 06 1265 PENPONT WATER - TRELYN BRIDGE (SX 2000 8288)

The Summer 1994 BMWP and ASPT scores were indicative of good water quality and typical of those associated with a moorland river. The very high ASPT obtained indicates the high proportion of organic tolerant taxa within the macroinvertebrate community. The current biological quality of this stream is consistent with previous years.

NRA 06 1266 PENPONT WATER - TWO BRIDGE (SX 2695 8165)

The Summer 1994 BMWP and ASPT scores for this site were the lowest recorded over the last 3 sampling years and were indicative of poor biological quality. This site has been subject to a deterioration in biological quality since Autumn 1990 at which time excellent quality was recorded. The decline in quality is reflected by the loss of organic tolerant taxa which tends to implicate chronic organic enrichment as the potential problem.

SUMMARY

The River Inny catchment is of reasonably good water quality. However there would appear to be problems with organic enrichment both at NRA 06 5227 upstream Davidstow Creamery and NRA 06 1266 at Two Bridges on the Penpont Water.

APPENDIX E

THE ROADFORD STRATEGIC SUPPLY SYSTEM:

The Roadford Reservoir scheme was built to meet the forecast rising demands in Plymouth, South West Devon and North Devon until well into the 21st century. Roadford followed Wimbleball and Colliford as the third strategic reservoir in Devon and Cornwall.

The Roadford Strategic Supply Zone covers a large part of Devon as well as North East Cornwall. The zone is served by 3 reservoirs (Roadford, Meldon and Burrator) and river abstractions on the Tamar, Tavy, Dart and Taw. The conjunctive use of all these sources provides supplies of water to Plymouth, South Hams and Torbay as well as Bideford, Barnstaple and parts of North East Cornwall.

Sources In The Tamar Catchment:

- Roadford Reservoir
- Gunnislake River Abstraction

Related Sources

Besides the sources in the Tamar catchment are a number of related sources in other catchments which are used conjunctively with the Tamar sources:

Burrator Reservoir (Meavy Catchment)

This is a direct supply reservoir which supplies water to Crownhill WTW (for Plymouth) but can also supply raw water into the transfer main across to Littlehempston WTW in the Dart catchment. In addition, the reservoir is used at times to support a local demand via Dousland WTW.

Devonport Leat (Dart Catchment)

The Devonport Leat, originally constructed in the late 18th century, conveys water from three tributaries in the headwaters of the West Dart across the catchment divide into the Meavy catchment. The water is used to supply local demand via Dousland WTW near Burrator Reservoir. Following an undertaking given at the Roadford Public Enquiry (1978) the water abstracted from the headwaters of the West Dart is now subject to prescribed flow conditions to protect river ecology downstream.

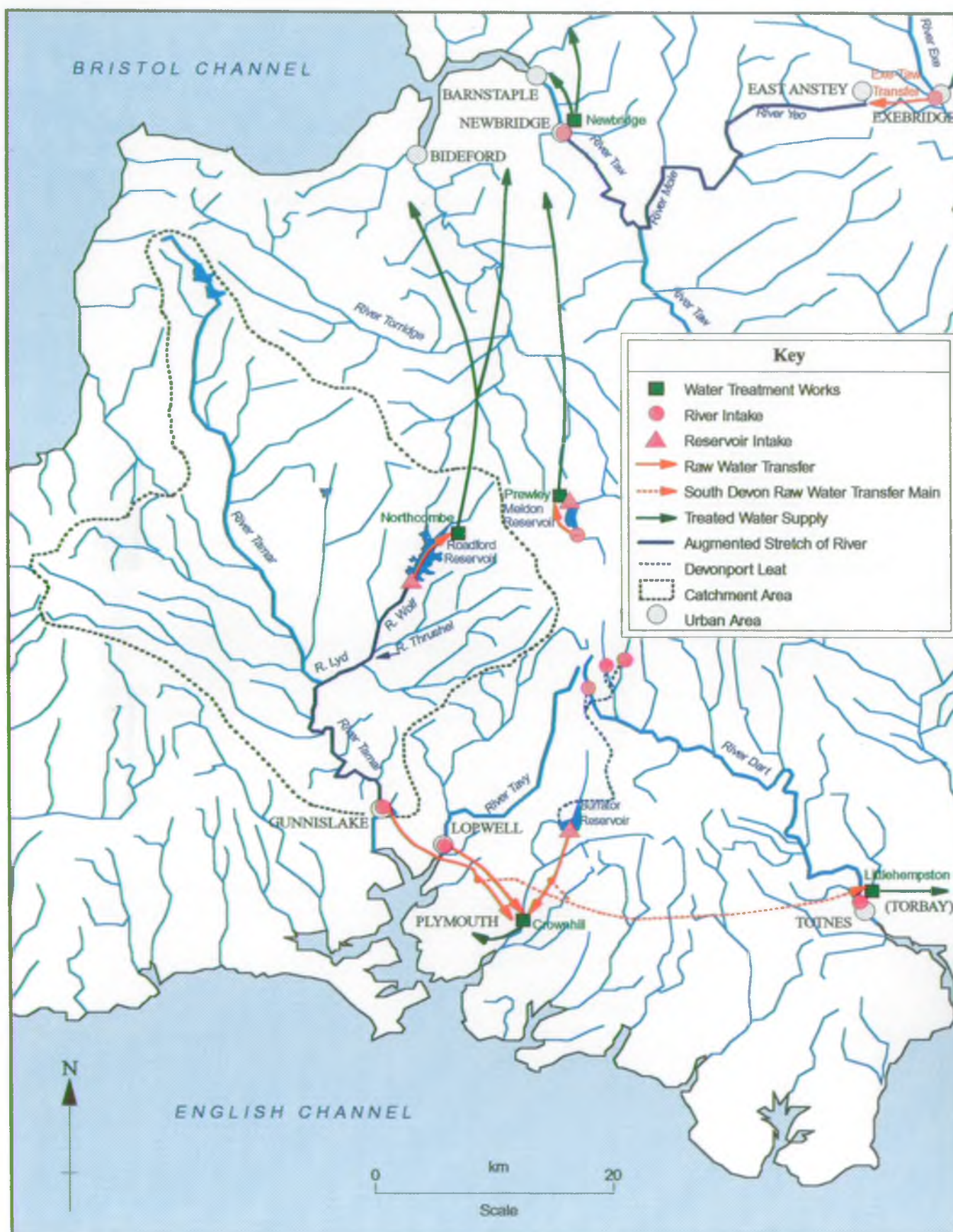
Lopwell Abstraction (Tavy Catchment)

Water is abstracted from the River Tavy, just above the tidal limit at Lopwell dam. The water can be pumped to Crownhill WTW for supply to Plymouth. A prescribed flow condition operates at this site.

Littlehempston Abstraction (Dart Catchment)

Water is abstracted from the River Dart near Totnes and pumped to Littlehempston WTW for supply to the local area. At times of high demand (for example the Summer tourist season) supply is augmented using the raw water transfer main conveying water from either Burrator or the Tamar.

Appendix E - The Roadford Supply System



Newbridge Abstraction (Taw Catchment)

Water is abstracted from the River Taw at Newbridge to supply part of North Devon. This operates both as an unsupported and a supported source (Exe-Taw Transfer), governed by a prescribed flow condition. The abstraction licence expires in June 1995. In the event that the undertaker demonstrates a future need for this source, any application to the NRA for a new licence would need to be supported by an adequate environmental assessment.

The Witheybrook at Bastreet

Water is abstracted from the Witheybrook at Bastreet in the upper reaches of the Lynher catchment. This operates as both as an unsupported and supported source (via a transfer into the Witheybrook from Siblyback Reservoir), governed by a prescribed flow condition. Above the prescribed flow of 2.25 Ml/d SWWSL are authorised to abstract up to 9.09 Ml/d (subject to a 50% take rule when flows are below 9.09 Ml/d) plus any quantity transferred into the Brook from Siblyback Reservoir in the Fowey catchment. The abstracted water is pumped to Bastreet WTW for local supply to Launceston and the surrounding area.

APPENDIX F

CATEGORIES OF POLLUTION INCIDENTS

Pollution incidents are divided into four categories:

Category 1 MAJOR

A major pollution incident which includes one or more of the following criteria:

- a) **Persistent effect on Water Quality**
Potential or actual persistent effect on water quality or aquatic life due to a discharge or spillage to controlled waters of any substance which is likely to have a persistent impact on the use or quality of that water.
[NOTE:- Persistent for the purposes of this paper means an environmental impact in excess of 21 days.
The inclusion of potential effect allows for those incidents where extensive remedial actions have been instigated by either the NRA or others which have prevented any actual release of pollutant into controlled waters].
- b) **Closure of an abstraction**
Closure of a potable water, industrial or agricultural abstraction necessary.
- c) **An Extensive fish - mortality**
A fish mortality in excess of 100 fish of any species of particular importance to the affected waters.
- d) **Excessive breaches of Consent Conditions**
A major or repeated failure of an effluent treatment plant which results in an excessive contravention of consent conditions together with a readily observable impact on the receiving water.
- e) **Instigation of remedial measures**
The instigation of extensive remedial measures by the NRA or other organisations either to forestall pollution or to alleviate the effect of a pollution incident eg. deployment of heavy plant, fish rescue equipment or major oil containment and recovery equipment etc.
- f) **Effect on amenity value**
Potential or actual adverse effect on an EC designated bathing water or other popular bathing beach or the cancellation of an important recreational event or activity.
- g) **Effect on conservation**
Potential or actual adverse effect on a designated Site of Special Scientific Interest or other site of particular conservation importance.

Category 2 SIGNIFICANT

A significant pollution incident involving one or more of the following criteria:

- a) **Notification of abstractors**
Potential or actual impact on water quality that necessitates notifying either surface water abstractors downstream of the incident location or groundwater abstractors in the vicinity of the discharge point.
- b) **A Significant fish mortality**
A fish mortality of between 10 and 100 fish of any notable species of importance to the affected waters.

The lower limit of 10 fish can be reduced if the fish affected are of a species of particular importance to the waters affected eg. adult migratory salmonids.
- c) **Effect on Invertebrate Life**
A readily observable effect on invertebrate life.
- d) **Water unfit for stock watering**
The water quality has been reduced unfit for stock watering and the Authority has advised farmers affected.
- e) **Bed of watercourse contaminated**
The bed of the watercourse is heavily contaminated by fungal/bacterial growths, sewage debris or particulate matter.
- f) **Reduction in amenity value**
Aesthetic quality significantly affected in terms of appearance or odour so as to affect amenity value of downstream users, for example anglers or canoeists.

Category 3 MINOR

A minor pollution incident which has resulted in a localised environmental impact only. Some of the following criteria may apply:

- a) Notification of abstractors not necessary.
- b) A fish mortality of less than 10 fish of any species not of particular importance to the waters affected.
- c) No readily observable effect on invertebrate life.
- d) Water has not been rendered unfit for stock watering.
- e) Bed of watercourse locally contaminated around point of discharge.
- f) Minimal environmental impact and amenity value only marginally affected.

Category 4 UNSUBSTANTIATED

A reported pollution incident which upon investigation proves to be unsubstantiated.

APPENDIX G

NRA POLICY AND PRACTICE FOR THE PROTECTION OF GROUNDWATERSummary Guide

In order to provide a framework for decision making, the NRA published its "Policy and Practice for the Protection of Groundwater" (PPPG) in December 1992. This document is available separately from HMSO. This appendix serves as a guide to how the policy is implemented, the NRA's principal concerns regarding threats to groundwater and to emphasise that we all have a part to play in protecting a valuable resource.

The policies are related to the risk posed by the activity taking into account the vulnerability of groundwater to pollution and paying particular attention to protecting the groundwater used for public water supply.

The NRA is engaged in a national programme of designating Source Protection Zones within these public supply catchments according to agreed criteria and following a timetable which should see completion by 1998. In accordance with the PPPG three zones of decreasing risk will be defined.

Zone 1 - The Inner Source Protection Zone will be that area defined by a 50 day travel time from any point below the water table to the source (and as a minimum of 50 metres radius from the source).

Zone 2 - The Outer Source Protection Zone is that area defined by a 400 day travel time from any point below the water table to the source.

Zone 3 - The Source Catchment is that area within which all groundwater will eventually discharge to the source.

The PPPG provides guidance on the acceptability of activities within such zones and in the absence of completion of the zonation maps the NRA will advise on the suitability of proposed development locations on the basis of existing information. In order to ensure sources will be properly protected, prior to these zones being established, we are also defining "Source Consultation Zones" within which we will seek referral of particular development activities to assess source protection requirements.

Another key element in the strategy to protect groundwater resources on a regional scale is the production of Groundwater Vulnerability Maps covering England and Wales at a scale of 1:100,000 identifying areas in which groundwater resources are vulnerable according to properties of the soil and underlying strata and require protection from potentially polluting activities. The maps are designed to be used by planners, developers, consultants and regulatory bodies to ensure that developments conform to PPPG. The programme of map production is on-going with map completion expected during 97/98. In the absence of such map information the NRA will advise on the suitability of proposed development locations.

Outlined overleaf are the key policy areas and NRA concerns regarding the protection of groundwater. In some cases the NRA can utilise its own powers but more often the NRA will need to influence other bodies, particularly local planning authorities and developers in order to achieve pollution prevention objectives. Please refer to the full PPPG document for detailed and informed policy interpretation.

**NATIONAL RIVERS AUTHORITY - SOUTH WESTERN REGION
POLICY AND PRACTICE FOR THE PROTECTION OF GROUNDWATER -SUMMARY GUIDE**

	POLICY STATEMENT	PRINCIPAL CONCERNS AND CONTROLS
A	Control of Groundwater Abstractions	No derogation of existing water rights. No unacceptable detriment to watercourse or water feature dependent on groundwater. No deterioration to water quality by incursion of saline or polluted waters. Controls through Abstraction Licences under Water Resources Act [WRA] 1991.
B	Physical Disturbance of Aquifers and Groundwater Flow	Effects on water resources from proposals that physically disturb aquifers, lower groundwater levels, impede or intercept groundwater flow. For instance; quarrying and gravel extraction, mining, construction of highways, railways, cuttings and tunnels, landfill using impermeable materials, borehole construction and abandonment activities that interconnect naturally separate aquifers. Interception of recharge waters. NRA seeks controls through the planning process.
C	Waste Disposal to Land	Pollution risks to groundwater from landfill and other waste related activities including; incinerators, transfer stations, civic amenity sites, waste chemical treatment plants, storage of special wastes and scrapyards. Controls as a statutory consultee to planning authorities & the Waste Regulation Authority.
D	Contaminated Land	Pollution risks from derelict land in a contaminated state, due to disturbance during re-development or from active industrial sites. Contaminated land may include land currently or previously used in connection with coal gas production, landfill sites and other waste disposal activities, waste lagoons, chemical manufacture, heavy industry, mining, sewage treatment works, metal and oil refining and hydrocarbon storage. The NRA seeks controls through the planning process & negotiation with developers.

	POLICY STATEMENT	PRINCIPAL CONCERNS AND CONTROLS
E	<p>The Application of Liquid Effluent, Sludges and Slurry to Land.</p> <p>- Agricultural Wastes</p> <p>- Sewage Sludge</p> <p>- Controlled Waste</p>	<p>Risk to groundwater quality dependent upon the chemical and microbiological content of the waste, the rate, method and timing of application and groundwater vulnerability.</p> <p>Produced from various farming activities including animal wastes and silage liquors. The NRA will liaise with farmers and seek to encourage them in the preparation of waste management plans for their farms. These should include the drawing up of a map identifying land suitable for the spreading of farm effluent without detriment to groundwater. The NRA seeks control through the MAFF guide; the Code of Good Agricultural Practice for the Protection of Water.</p> <p>Produced exclusively at sewage works and disposed of by sewage undertakers or their contractors. Control through liaison with Statutory Undertakers. HMIP Competent Authority for Sludge(Use in Agri) Regs.</p> <p>Industrial effluent sludges, both organic and inorganic in nature and including septic tank contents. Control through consultation with Waste Regulation Authorities on Registration of Exemptions under Environmental Protection Act 1990.</p>
F	Discharges to Underground Strata	<p>Protection of groundwater quality by NRA control of discharges under the Water Resources Act 1991 through consenting or prohibiting discharges to groundwater either direct or via a soakaway. No consented discharge of List 1 substances to underground strata. Sealed effluent storage tanks for domestic sewage effluent in Zone 1 in the absence of main sewer.</p> <p>Discharges of sewage effluent to groundwater from new septic tanks or STW's over 5 cubic metres/day will be controlled. Discharges under 5m³/d will be controlled when groundwater judged at risk.</p>
G	Diffuse Pollution of Groundwater	<p>Groundwater contamination arising through aerial spread of pollutants e.g. Nitrates/Pesticides, and the cumulative effects of many individual pollution events e.g. farm wastes or industrial solvent spillages. Controls possible under Section 94 of the Water Resources Act (WRA) 1991 i.e. Nitrate Sensitive Areas. Also Discharge Consent Controls and Regulations [Section 92] of WRA 1991 e.g. Silage, Slurry and Agricultural Fuel Oil Regulations.</p>

	POLICY STATEMENT	PRINCIPAL CONCERNS AND CONTROLS
H 1	Additional Threats Production, Storage & Use of Chemicals [Raw & Waste]	Point source risk to groundwater quality. Controls through Planning (Hazardous Substances) Act 1990 which applies to new storage of significant quantities of specific hazardous substances and the NRA is a statutory consultee. Otherwise the NRA seeks controls through planning process. Normally the NRA will object to proposals within Zones 1 & 2. Storage of waste may require a Waste Management Licence [NRA are a Statutory Consultee].
H 2	Storage of Farm Wastes and Intensive Livestock Housing	In vulnerable locations leachate from stored wastes or effluent from intensive livestock housing can be highly polluting. Control through the Silage, Slurry and Agricultural Fuel Oil Regulations 1991 for all new, substantially enlarged or reconstructed installations. The Code of Good Agricultural Practice of the Protection of Water [MAFF 1991] offers guidance generally. The NRA wishes to discourage the establishment of farm waste storage areas and substantial livestock housing within the Inner Source Protection Zone (Zone 1) unless adequate measures can be agreed to minimise the risk of pollution. The NRA seeks controls through the planning process.
H 3	Graveyard and Animal Burial Sites	Large graveyards are a potential threat to groundwater quality. New sites or extensions are opposed within Zone 1. The NRA seeks controls through the planning process. Animal burial sites would be rejected in Zone 1. The Code of Good Agricultural Practice provides guidance.
H 4	Sewage Works, Foul Sewers and Storm Overflows.	Risk of contamination to groundwater resources. New STW's opposed in Zones 1 & 2. New sewers opposed in Zone 2. NRA seeks controls through the planning process. Sewage works and storm overflows are controlled by Discharge Consents through WRA 1991.

	POLICY STATEMENT	PRINCIPAL CONCERNS AND CONTROLS
H 5	Additional Threats[Cont'd] Oil and Petroleum Storage and Transport via Pipelines	<p>Groundwater pollution through leakage from underground tanks and accidental rupturing of tanks and pipework.</p> <p>Storage Regulations expected under Section 92 WRA 1991, similar to H2 above. New hydrocarbon storage opposed to in Zone 1. Underground storage of hydrocarbons discouraged in Zones 2 & 3. NRA seeks controls through the planning process.</p> <p>Oil pipeline routes opposed in Zone 1 and discouraged in Zones 2 & 3. NRA seeks controls through the Planning process.</p>
H 6	Major Developments and Infrastructure	<p>Drainage from major roads or railways can pose risks to groundwater due to spillages after accidents as well as changes to discharge and run-off patterns. Major communications routes would be opposed in Zone 1</p> <p>Developments such as airfields, industrial parks and large areas of vehicle parking may involve storage / loading / unloading of hydrocarbons, solvents and other potentially contaminating substances. Such developments would be opposed in Zone 1. The NRA seeks control through planning process.</p> <p>Discharges from highway drains and contaminated site drainage can be controlled by prohibition notices and discharge consents.</p>

GLOSSARY**ABSTRACTION**

Removal of water from a surface or groundwater source of supply.

ADIT

Gently sloping passage from mine workings into valley areas to allow water to drain out of the working. (The downstream entrance is called the adit portal).

ALLUVIAL DEPOSITS

Sedimentary deposits resulting from the erosive action of rivers. Typically, fine grained material carried by the river and deposited in areas such as flood plains, but often including sandy or gravelly beds too.

ANNEX 1A SUBSTANCE

Substance which has been selected for monitoring on the basis of its persistency, toxicity and ability to bioaccumulate.

AQUIFER

Layer of porous rock able to hold and transmit water. Often classified as major, or minor, depending on the extent to which they support higher yielding borehole systems.

AUGMENTATION

The support of a downstream river abstraction by releasing (usually) equivalent quantities of water from an upstream source (whether it be a reservoir or borehole).

BASEFLOW

The flow in a river comprising emergent groundwater sources. In dry conditions river flows comprise entirely of baseflow.

BIOACCUMULATION

Concentration of pollutant substances, such as metals, within the tissues of organisms.

BIOCHEMICAL OXYGEN DEMAND (BOD)

A measure of the amount of oxygen consumed in water, usually as a result of organic pollution.

BRYOPHYTES

Mosses and liverworts.

BUFFER ZONE

Strip of land 10-100m wide, alongside rivers which is removed from intensive agricultural use and managed to provide appropriate habitat types. Benefits include reduction of inputs into the river such as silt, nutrient, livestock waste, as well as improving habitat diversity and landscape.

CAMBIC STAGNOGLEY SOILS

Soils with a distinct topsoil and no clay-enriched sub-soil.

CHERT

A hard sedimentary rock very similar to flint.

COMPENSATION FLOW

A defined release from a reservoir to compensate for the impact of the impoundment by maintaining a minimum flow in the river downstream.

CONJUNCTIVE USE

The operation of two or more sources in a systematic manner to provide a yield greater than the sum of those sources if operated independently.

CONSENT

A statutory document issued by NRA under Schedule 10 of Water Resources Act 1991 to indicate any limits and conditions on the discharge of an effluent to a controlled water.

CRITICAL LOAD

The maximum load of a pollutant which a given ecosystem can tolerate without suffering adverse change. The Department of Environment has calculated critical loads for freshwaters in the UK, compared them with the non-marine inputs of sulphur, and derived maps which indicate where critical loads for acidity for freshwaters are currently exceeded. Forest planting proposals within these areas are likely to require a catchment-based assessment to determine the susceptibility of surface waters.

CULVERT

Channel or conduit carrying water across or under a road, canal etc.

CYPRINID

Fish of the carp family (i.e. coarse fish)

DE-WATERING

Removal of groundwater to reduce flow rate or diminish pressure.

DROUGHT ORDER

Drought Orders are made by the Secretary of State upon application by the National Rivers Authority or a water undertaker, under powers conferred by Act of Parliament, to meet deficiencies in the supply of water due to exceptional shortages of rain. The terms and conditions under which Drought Orders may be obtained are given in Sections 73-81 of the Water Resources Act 1991. Drought Orders are sub-divided into "Ordinary" and "Emergency" Drought Orders. A Drought Order could contain provisions such as; to authorise abstraction from an unlicensed source, override the conditions on an existing abstraction licence, limit the amount of water which may be taken from a source, vary discharge conditions or might allow the prohibition of use of water for particular purposes, to allow a ban on non-essential use of water (for example in car washes) or to introduce the use of stand-pipes.

ECOSYSTEM

A functioning, interacting system composed of one or more living organisms and their effective environment, in a biological, chemical and physical sense.

ENVIRONMENTAL QUALITY STANDARD (EQS)

The quantity of a substance found in a body of water which should not be exceeded in order to protect a given use of the water body. An EQS is set by the European Community through EC Directives and the government.

ENVIRONMENTALLY SENSITIVE AREA (ESA)

Area where the landscape, wildlife and historic interest are of national importance. Payments are made by Agriculture and Fisheries Departments for appropriate sensitive land management.

ESCAPEMENT

Numbers of fish that survive to spawn

EVAPOTRANSPIRATION

Loss of water by land plants due to evaporation and transpiration.

EUTROPHICATION

The enrichment of water by nutrients, especially nitrogen and/or phosphorous, which causes: 1) accelerated growth of algae and higher plant life, 2) changes in the ecological balance, and 3) deterioration in water quality.

FAULT

Plane surface of fracture in a rock body, along which observable relative displacement has occurred between adjacent blocks.

FISSURE

A crack or open break in rocks.

FISH SURVEY

Electric-fishing survey of between 1 and 3 runs within a stop-netted section of river.

FLUVIAL

Pertaining to river flow and its erosive activity.

FRY

Juvenile salmonids that have left the gravel and are less than one year old.

GLEYSOILS

One of the seven major groups in the soil classification of England and Wales. They are characteristically affected by periodic or permanent saturation by water in the absence of effective artificial drainage.

GRILSE

Atlantic salmon that have remained in the sea for only one winter.

GROUND TRUTHING

Investigations to check that the situation on the ground matches desk-top studies.

HYDROGEOLOGY

Branch of geology concerned with water within rock bodies or bedrock.

LEACHATE

Solution formed when water percolates through a permeable medium. Can be mineral-rich, toxic or even carry bacteria.

LICENCE OF ENTITLEMENT

Licence granted under Schedule 26 of the Water Act 1989 in respect of a previously exempt abstraction greater than 20m³/day which required a licence by virtue of an amendment to Section 24(2) and (3) of the Water Resources Act 1963. (Covered particular domestic and agricultural uses, including fish farming and flows to domestic amenity ponds)

LICENCE OF RIGHT

Licence granted under Section 23 of the Water Resources Act 1963 in respect of an abstraction which was already in operation when that Act was passed.

MACROINVERTEBRATE

A large invertebrate eg. mayfly, snail, fly.

MAIN RIVER

Some, but not all, watercourses are designed as 'Main River'. 'Main River' status of a watercourse must be first be approved by MAFF. Statutory (legally binding) maps showing the exact length of 'Main River' are held by MAFF in London and the NRA in Regional Offices. The NRA has the power to carry out works to improve drainage or protect land and property against flooding on watercourses designated as 'Main River'. The NRA do not have the legal power to spend public funds on drainage or flood protection works on watercourses not designated as 'Main River'.

METAMORPHIC AUREOLE

The area around an intruded magmatic body, eg. granite, where the country rock has been altered and affected by the heat.

MINIMUM ACCEPTABLE FLOW (MAF)

A prescribed flow in a river set by the Secretary of State under Section 21 of the Water Resources Act 1991, in order to protect the riverine and fisheries environment and/or to ensure the acceptable dilution of effluent discharges and the protection of legitimate riparian interests.

MITIGATION

Rearing of stock salmonids to compensate for loss of juvenile production as a result of major impoundments (dam construction).

MULTI SEA WINTER

Atlantic salmon that have remained in the sea for two winters or more.

NATURAL AREA

The whole of England has been described as a series of ecologically distinct areas following survey work by English Nature.

ORDINARY WATERCOURSE

A Flood Defence term, not relevant to other functions. A watercourse that does not form part of a main river.

PARR

Juvenile salmonids aged one year and older.

PERMEABILITY

A measure of the ease at which liquids (or gases) can pass through rocks or a layer of soil.

PREVIOUS SPAWNER

Salmonids that are returning to spawn for a second or subsequent occasion.

PODZOLIC SOILS

Well drained black or dark brown soils, with a compact subsurface horizon enriched in humus and normally overlain by a bleached layer.

POROSITY

The volume of water which can be held within a rock or soil, expressed as the ratio of the volume of the void space to the total volume of the material.

POTABLE

Water of a quality suitable for drinking.

PRESCRIBED FLOW (pf)

Flow below which a river must not be reduced as a result of abstraction.

PRESCRIBED FLOW CONDITION

A prescribed flow condition is a trigger for abstraction to be reduced or cease unless supported by artificial releases. Often a specific condition on abstraction licenses to protect the river environment and other legal users.

Q95

The flow that on average is equalled or exceeded for 95% of the time.

REDD

Hollow created in river bed gravels by spawning salmonid fish into which the female deposits ova.

RELIABLE YIELD

The output capacity of a reservoir, reservoir system, conjunctive use scheme etc. It is the average output (volume/day) that can be sustained through a design drought period. 1976 has been regarded as the critical historical drought sequence, with a risk of occurrence regionally of approximately 1:50 years but current research into extended flow sequences back to the last century and modelling particular water supply schemes suggests that 1975-76 may be much more severe than a 1:50 years sequence.

RESERVOIR PUMPED STORAGE

The supplementation of the natural inflow to a reservoir with river water abstracted downstream or transferred between catchments, and pumped to the reservoir at times of high flow. Pumped storage ensures

that the reservoir is refilled sufficiently for the start of the next Summer drawdown period.

RIFFLE

Stony or gravelly part of river bed shallow in dry weather flow. Fast streams on most non-chalk areas have alternating riffles and pools.

RIFFLE SURVEY

Electric-fishing survey on riffle areas for 20 minutes with no stop nets.

RIPARIAN OWNER

Owner of riverbank and/or land adjacent to a river. Normally owns riverbed and rights to at least midline of channel.

RIPARIAN ZONE

Zone alongside watercourse stretching from top of channel to next change in land form (most often banks) or vegetation type.

RIVER CORRIDOR

Land which has visual, physical or ecological links to a watercourse and which is dependent on the quality or level of the water within the channel.

RIVER QUALITY OBJECTIVE (RQO)

The level of water quality that a river should achieve in order to be suitable for its agreed uses.

RIVER REGULATION

The maintenance of a stated flow in rivers in order to allow abstraction to continue during times of low flow and for environmental protection. This is achieved as for river augmentation by supporting river flows using upstream sources.

SALMONID

Game fish of the salmon family eg. salmon, brown trout and sea trout.

SEA LICE

Parasite found on salmon who have recently returned to freshwater. Cannot survive long in freshwater.

SMOLTS

Young salmonids migrating to sea for the first time and adapted to life in salt water.

STAGNOGLEY SOILS

Seasonally waterlogged, slowly permeable soils, prominently mottled, with a distinct topsoil.

TASK FORCE

An intensive investigation of possible sources of pollution following non-compliance in the catchment.

TRANSMISSION LOSSES

Transmission losses comprise 'river losses' and 'operational augmentation losses'. River losses' relate to identified losses through the bed or banks and estimates of surface water evaporation. Operational augmentation losses can be from errors in forecasting (when augmentation releases need to start and end), resulting in augmentation releases on days they are not required or when demand is lower than forecasted and water is released in excess of abstraction needs.

TWO SEA WINTER (2SW)

Atlantic salmon that have remained in the sea for two complete and consecutive winters

UNITS

mm	Millimetres
m	Metres
km	Kilometres
km ²	Kilometres squared
persons/km ²	Number of people per kilometres square
ha	Hectares
m ³ /s	Cumecs; cubic metres per second
m ³ /day	Cubic metres per day
MI/day }	Megalitres per day
MI/d }	
MI/y	Megalitres per year
Kg/day	Kilogrammes per day
tonnes	Metric tonnes
%	Percentage
>	Greater than
≥	Greater than or equal to
<	Less than
≤	Less than or equal to

ABBREVIATIONS:

AGLV	Areas of Great Landscape Value
ALF	Alleviation of Low Flow
AMP2	Asset Management Plan 2
AOD	Above Ordnance Datum
AONB	Area of Outstanding Natural Beauty
BASIS	British Agro-chemical Standards Inspection Scheme
BCU	British Canoe Union
BOD	Biochemical Oxygen Demand
CAP	Common Agricultural Policy
CBWPS	Cornwall Birdwatching and Preservation Society
CBRU	Cornwall Biological Records Unit
CoCom	Countryside Commission
COGAP	Code of Good Agricultural Practice
CCC	Cornwall County Council
CLA	Country Landowners Association
CMP	Catchment Management Plan
CNC	Cornwall Nature Conservation Site
CPRE	Council for the Protection of Rural England
CWT	Cornwall Wildlife Trust
DoE	Department of the Environment
DLG	Derelict Land Grant
DWT	Devon Wildlife Trust
EC	European Commission
ECC	English China Clays
EN	English Nature
EQS	Environmental Quality Standards
ERLOS	Emergency Response Levels Of Service
ESA	Environmentally Sensitive Areas
FA	Forestry Authority
FC	Forestry Commission

UNITS & ABBREVIATIONS

FDMF	Flood Defence Management Framework
FE	Forest Enterprise
GATT	General Agreement on Trade and Tariffs
GQA	General Quality Assessment
GIS	Geographical Information System
HC	Harbour Commissioners
HMIP	Her Majesty's Inspectorate of Pollution
LNR	Local Nature Reserve
LOE	Licence of Entitlement
LOR	Licence of Right
LPA	Local Planning Authority
MAFF	Ministry of Agriculture, Fisheries and Food
MMC	Mergers and Monopolies Commission
NFU	National Farmers Union
NGR	National Grid Reference
NLO	Net Limitation Order
NNR	National Nature Reserve
NRA	National Rivers Authority
NSA	Nitrate Sensitive Area
NT	National Trust
NVZ	Nitrate Vulnerable Zone
NWC	National Water Council
OFWAT	Office of Water Services
PCB	Poly Chlorinated Biphenyls
R&D	Research and Development
RCS	River Corridor Survey
RE	River Ecosystem, RE1, RE2 etc.
RHS	River Habitat Survey
RQO	River Quality Objectives
RSPB	Royal Society for the Protection of Birds
SAGLV	Special Area of Outstanding Natural Beauty
SAM	Scheduled Ancient Monuments
SSO	Storm Sewer Overflows
SSSI	Sites of Special Scientific Interest
STW	Sewage Treatment Works
SWQO	Statutory Water Quality Objective
SWWSL	South West Water Services Limited
S105 Surveys	Section 105 of the Water Resources Act allows for Standards of Service, Assets and Flood Risk Surveys
UWWTD	Urban Waste Water Treatment Directive
WQO	Water Quality Objectives
WRA	Waste Regulation Authority
WT	Woodland Trust
WTW	Water Treatment Works

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Telephone the emergency hotline to report all environmental incidents, such as pollution, poaching and flooding, or any signs of damage or danger to our rivers, lakes and coastal waters. Your prompt action will help the NRA to protect water, wildlife, people and property.



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