

**RIVER TAMAR
CATCHMENT MANAGEMENT PLAN
DRAFT CONSULTATION REPORT**

**1ST DRAFT
INTERNAL CONSULTATION
Cornwall Area Catchment Planning
17 March 1995**

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.



CATCHMENT VISION

- * most societies want to achieve economic development to secure a better quality of life, now and in the future.
- * they also seek to protect their environment now and for their children.

Sustainable development tries to reconcile these two objectives - meeting the needs of the present without compromising the ability of future generations to meet their own needs.

To achieve this judgements have to be made about the weight to be put on different factors in particular cases. Sometimes environmental costs have to be accepted as the price of economic development but on other occasions a site, or an ecosystem, or some other aspect of the environment has to be regarded as so valuable that it should be protected from exploitation.

As Guardians of The Water Environment of the Freshwater Tamar catchment it is the role of the National Rivers Authority to present the case to protect the water environment from damage; sustaining and extending its environmental value and interest whilst commercial, industrial and recreational use continues to be made of it.

In an area of such high amenity and ecological value as the Freshwater Tamar the NRA's vision of the future is towards a catchment where:

- * The aquatic biodiversity of the catchment is maintained and extended.
- * improvements continue to be made to existing discharges, meeting the most stringent appropriate standards.
- * the risk to the water environment from abandoned mine workings is eliminated.
- * an agricultural and forestry system develops which reduces the risk of diffuse pollution and improves the physical habitat of the river system and wetlands for wildlife.
- * The public's enjoyment and appreciation of the river system continues to grow.
- * There is minimal risk to people and property from flooding.

3.0 INTRODUCTION

This Catchment Management Plan Consultation Report

- * describes how the catchment is used
- * explains what we are doing to protect or restore the water environment.

Economic and political constraints will influence what we are able to do. The amount of money that the water service companies spend on pollution control will make a difference to the extent of water quality improvements.

3.1 Catchment Management Plans and Development Plans

While we can control some of the things which influence the quality of the water environment we have very little control over the way that land is developed. This is the responsibility of local planning authorities.

Local Authorities prepare statutory development plans. The policies in these plans will guide the way that land is developed in the future. We have published guidance for local planning authorities to encourage them to adopt policies which protect the water environment from harmful development. Where we can we will reinforce these policies when we comment on planning matters or if we are making our own decisions.

This Report will highlight where we are concerned about development.

3.2 The Consultation Report

This Consultation Report includes the following sections:

Catchment Characteristics

Provides a brief and general introduction to the catchment describing its key characteristics.

Catchment Uses

In the catchment there are activities which use the water environment. They may either have an impact on, or have certain requirements of the water environment. These various activities are discussed under "use" headings. We include notes on our role and objectives in managing or promoting this use and comments on the local (catchment) perspective.

Targets and State of the Catchment

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.

Issues and Actions

Where we are not reaching targets or fulfilling our objectives we identify issues. Where possible we identify actions to resolve issues. This section summarizes these issues and

proposed actions.

3.3 Your views

We hope that this report will be read by everyone who has an interest in the quality of the water environment.

Your views will help us finalise the Action Plan.

Have we identified all the problems in the catchment?

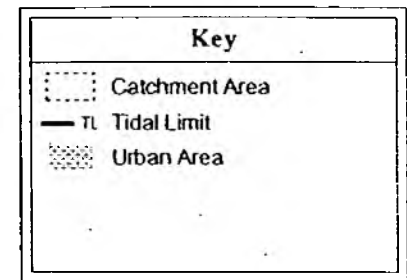
Are there any issues which you want to highlight?

Please send your comments to:***** by *****

3.4 The Action Plan

We will collate responses to this report and publish an Action Plan. Progress with the actions identified will be checked annually and a progress report published. Within 5 years of publishing the action plan we will do a major review of the progress we have made.

Base Map



CATCHMENT STATISTICS

Area drained:	927.75 km ²
Population:	32,900 (1991 Census)
Length of Main River:	167.05 km
Length of Controlled Water:	447.90 km
Annual Rainfall	998 mm (Davies)
Long Term Average (1940-70):	1460 mm (Altarnun)
Principal Towns:	Launceston Holsworthy
District Councils:	North Cornwall District Council Torridge District Council West Devon Borough Council Caradon District Council

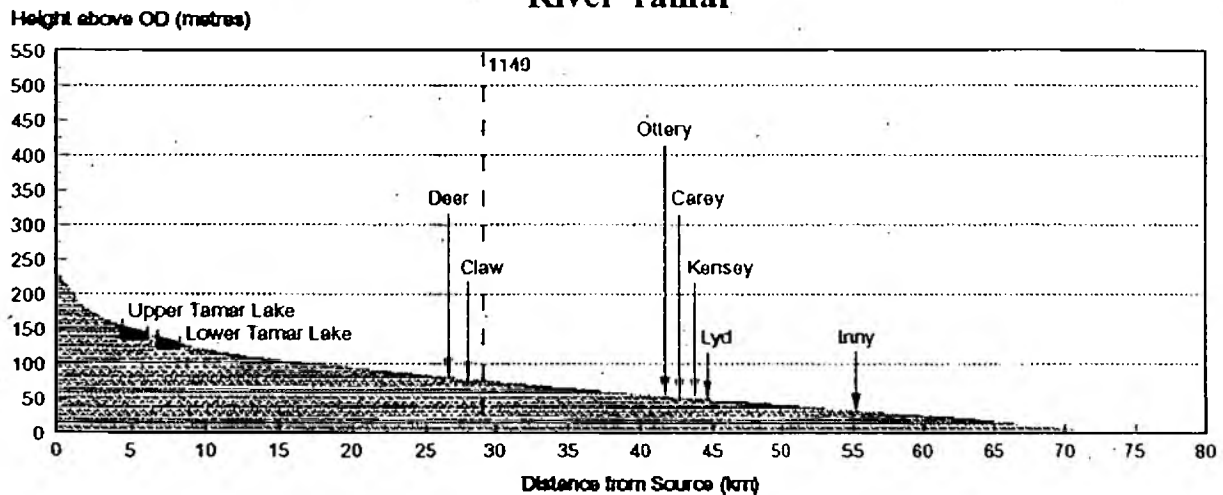
Table 1: Drainage areas

River	Area drained upstream of;	Area drained (km ²)	Length of river
Tamar	Gunnislake Weir	927.75	78.0
Carey	Tamar Confluence	68.0	21.5
Thrushei	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

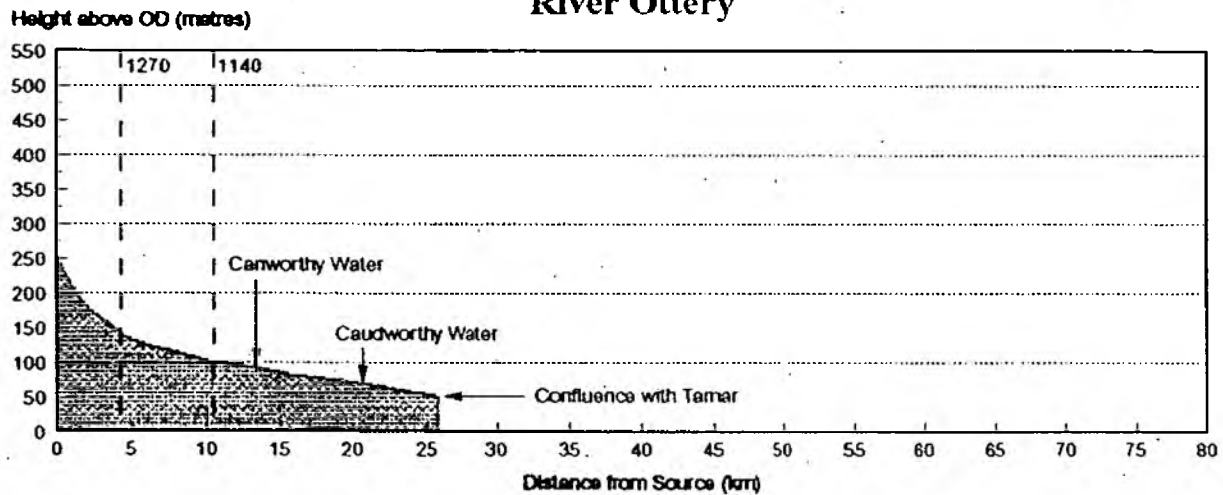
FRESHWATER TAMAR CATCHMENT

River Profiles

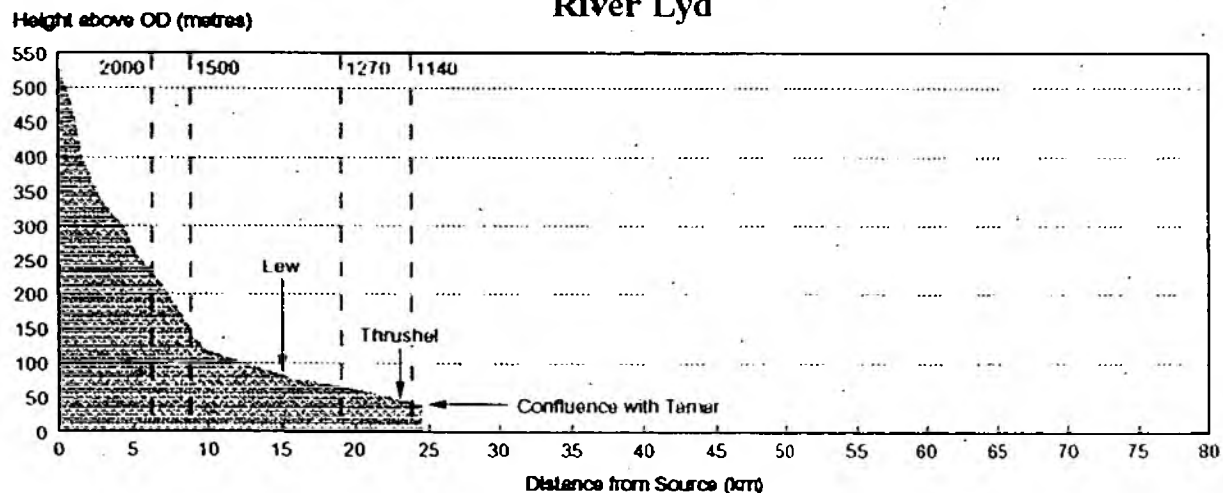
River Tamar



River Ottery



River Lyd



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

2.0 CATCHMENT DESCRIPTION

2.1 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 and is roughly rectangular in shape.

The River Tamar rises in the north of the catchment approximately 10 km north east of Bude and flows south through a broadening flood plain 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, 78 km from its source.

The flood plain is usually flat throughout the catchment and prone to flooding.

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

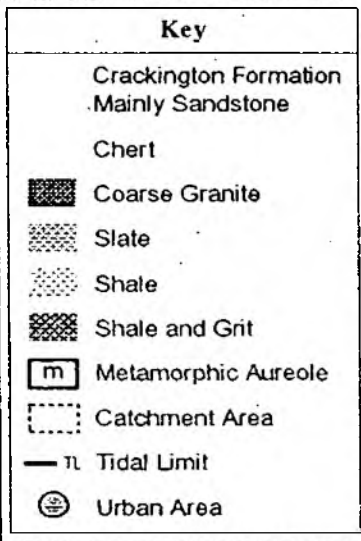
		Population census		% Change	
		1981	1991		
12J	Upper Tamar	5853	6605		+13%
12F	Lyd	2175	2350		+8%
12G	Thrushel & Wolf	1844	1952		+6%
12H	Carey	2007	2475		+23%
12M	Ottery	2140	2450		+14%
12N	Kensey	7045	7680		+9%
12P	Inny	2190	2505		+14%
12E	Lower Tamar	5577	6860		+23%
Total		28831	32877		+14%

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.

Geology



Soils

The most widespread soil types in the upper catchment are Halstow soils. These are slowly permeable clayey soils, easily waterlogged, that crack deeply in dry seasons and which are mainly used for permanent grassland, dairying and stock rearing.

In the middle of the catchment the most widespread soil type is "typical brown earths", with small pockets of "typical brown podzolic" soils found on some of the steeper slopes and small pockets of "cambic stagnogley" soils. They support less intensive land use: stock rearing, good quality moorland grazing and woodland.

The Lower Tamar valley consists of "brown alluvial" soils; deep, stoneless permeable silty soils supporting dairying and stock rearing.

Geology and Mineralisation

The rocks found throughout most of the Tamar catchment represent sediments, volcanic lava flows and associated basic igneous intrusions which were deposited within a deep sedimentary basin during Devonian and Carboniferous times. These rocks were subsequently deformed undergoing regional metamorphism with intense folding and thrusting. The resulting rocks include mudstones, shales, siltstones, sandstones and minor limestones of sedimentary origin and basalts, gabbros and 'greenstones' (metamorphosed volcanics) of volcanic origin.

Granite emplacement within these rocks, to east of the catchment on Dartmoor, centrally at Kit Hill and Hingston Down, and to the west on Bodmin Moor took place about 290-280 million years ago at the end of the Carboniferous period. This resulted in thermal contact metamorphism of the adjacent country rock and in more extensive hydrothermal mineralisation.

Intense Tin/Copper/Arsenic and locally Tungsten mineralisation is present along the alignment of the granite mass within predominantly East-West lode structures in the Gunnislake-Kit Hill-Callington-Hingston Down areas. Within this area and elsewhere, for example around Bere Alston. Lead/Zinc/Silver mineralisation is also present with predominantly North-South lode structures. Widespread localised Manganese mineral deposits are also present within the catchment. This mineralisation tends to be associated with chert and volcanic deposits.

Hydrogeology

The rocks underlying the Tamar catchment, while of differing origins, all have generally low permeability and porosity limiting groundwater flow and storage. However the rocks have been subject to widespread folding and faulting causing fractures and fissures where most storage and movement of groundwater occurs. At shallow depths weathering and other processes, such as soil creep down valley sides, have opened up the rock structure enhancing groundwater storage and permeability. Locally alluvium along river valley flood plains provides additional groundwater resources.

In such aquifers groundwater flow is generally limited to shallow depths and tends to follow the topography. However, locally, new drainage pathways have been provided by historic mining activities which can result in rapid flow 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.

The primary groundwater uses are for provision of river baseflow and to support numerous

small scale water supplies. Within the catchment there are 459 licensed groundwater abstraction sources used primarily for small scale potable and agricultural use (see 4.). It is estimated that a comparable number of unlicensed domestic supplies are present. These uses are highly vulnerable to contamination from escape of pollutants into the soil on account shallow water tables, low porosity and rapid flow within fractures.

2.3 Hydrology

The upper reaches of the catchment receives a high but evenly distributed rainfall, with average rainfall more than 1015 mm per year. The flows in the rivers are characterised by rapid rises and falls in water levels after periods of rainfall (a characteristic known as 'flashy'). At Gunnislake gauging station the Q95 flow (the flow which is exceeded for 95% of the time on average) represents 8% of the mean daily flow.

The effects of Roadford Reservoir and Tamar Lakes on the Wolf/Thrushel system and the Upper Tamar respectively is to reduce the flood peaks, extend the period of relatively high flows and increase low flows.

Further detailed information on the hydrology is given in Appendix A.

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 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 we 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, parts of which are covered by landscape designations.

Designated Areas (see map)

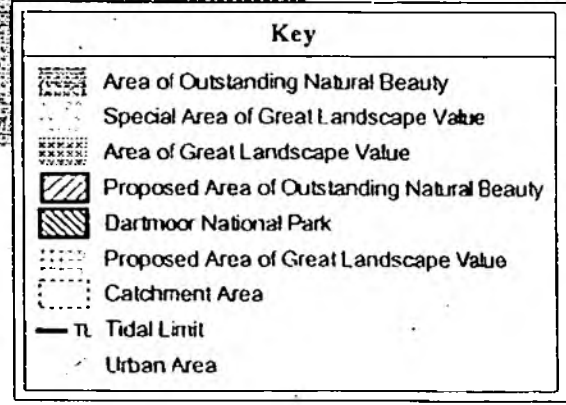
National Park

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.

Landscape Designation



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, which are significant in the County context. These areas are protected through the County Structure Plan. (.ref) North Cornwall District Council have proposed an area of the Tamar Valley from Tamartown to Stoke Climsland as a AGLV.

Landscape Character

Recent work by the Countryside Commission has defined the landscape types of England(ref.and check status.) About 75% 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, woody 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 (.ref) Funded by a number of agencies this is an integrated assessment of the area including character description, forces for change, management issues and recommendations for action. Some of these issues and options are directly related to the water environment and require NRA partnership and are picked up in 5.3.

Part of the 'Tamar Valley' landscape area extends over 15% of the southern catchment. It is characterised 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 marks 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 produced (.ref) highlighting landscape characteristics, threats, issues and actions, some of which are directly related to the water environment and require NRA partnership (see 5.3).

Two significant recent additions to the landscape of the area are Roadford Reservoir and the A30 Lifton/Lewdown bypass. Impact assessment was undertaken prior to construction of both and landscaping measures undertaken. Other impacts on the catchment are discussed in further sections of this Plan.

4.1.2 Wildlife

English Nature is developing a system of 'Natural Areas'. 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' nominally designated a Natural Area.

The prime conservation feature of the catchment is Culm Grassland, which makes up one of the greatest concentrations of species-rich grasslands in England and is of National significance. Culm grasslands are wet, acidic pastures over clayey, poorly drained soils. The vegetation that develops includes fen-meadow, rush-pasture and mire communities supporting a wealth of different plant, invertebrate and bird species. Nationally Culm Grassland is restricted to this part of Devon and Cornwall, and is recognised as a priority

habitat under the EU Habitats Directive. (ref) Between 1984 - 1989/90, 61% of Culm Grassland was lost, primarily through agricultural improvement. Largely due to extensive agricultural land drainage (see 4.?) only a scattering of small, fragmented sites remains. Measures already being undertaken by English Nature, Devon and Cornwall Wildlife Trusts, the Ministry of Agriculture Food and Fisheries and Local Authority countryside sections to conserve and restore Culm grassland. It remains a significant issue (see 5.3).

As well as an ecological resource an important natural function of Culm is as a natural filter. In the headwaters and upper catchment natural buffering can slow the rate of surface water run off delaying water release to the water courses. This also encourages suspended solids to settle out of suspension, preventing water quality problems (see 5.1).

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 (for more detail see 4.).

Moorland occurs on the south western (Dartmoor) and eastern (Bodmin) sides of the catchment. Below the granite tors, 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.

Across the catchment these fragments (areas) of semi natural habitat are linked by thick hedgerows, typical of the district, and by belts of trees along the banks of streams and rivers. This 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. The riparian vegetation plays a valuable role in water quality buffering, by slowing down runoff and enabling biological processes to operate properly.

One significant indicator in the water environment is the freshwater invertebrate community and the food chain this supports. The NRA undertakes routine biological monitoring throughout the catchment and compares actual results against a predicted score for the river type (see map), largely to monitor long term water quality. This is supported by data from fisheries and conservation surveys which focus on key indicator species which are indicative for the type of river in a high quality state, and invasive species which are seen as a threat to the sustainable diversity of native flora and fauna. Biological and fisheries data generally indicate a high quality water environment, supporting varied invertebrates, game and coarse fish. Localised problems, particularly metal contamination have reduced the diversity and abundance of both groups. More detailed information is given in Appendices ***

Designated Areas

Parts of the catchment have the following nature conservation designations:

Sites of Special Scientific Interest (SSSIs)

SSSIs are recognised as nationally important sites, and afforded specific protection through legislation. They are overseen by English Nature, who the NRA are obliged to consult if sites are likely to be affected by any developments or operations, directly undertaken or licensed.

Within the catchment there are 19 SSSIs (see Appendix x). Five of these are designated for their geological interest, 13 of the remaining 14 have some wetland or aquatic importance. Of these, 10 are Culm Grassland sites worthy of the highest protection. One quarter of the SSSI Culm Grassland are found within the catchment. Most sites, however, are very small and are vulnerable to deterioration either through agricultural intensification or agricultural neglect. Ironically, lack of grazing is damaging these sites.

National Nature Reserves (NNR)

Dunsdon Farm is designated a NNR (also SSSI) for its Culm grassland. This is managed specifically for conservation by English Nature.

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 Plan (..ref)) buffer zones around sites, wildlife corridors to link sites, and emphasise 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 emphasise the most important areas of nature conservation to concentrate resources.

Cornwall Nature Conservation Sites (CNC sites)

In the Cornish part of the catchment there are..... (from CWT) CNC sites covering % of land area. The reason for designation varies, however, many of the CNC sites are Culm grassland or valley woodland, for which the water environment is an essential component.

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 CWT also comments on specific development proposals.

The NRA also holds copies of the records for its own use and consults freely with the CWT.

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 a 'no-go' area for human recreation. 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. A birdwatching hide has been built on the SE side of the lake.

What about DWT sites?

Key Species

A number of vulnerable wetland species live within the catchment. These include:

i) Otter (*Lutra lutra*). Protected under EU legislation (..ref) and the Wildlife and Countryside Act (1981)(..ref), the largest population and greatest density of otters in England occur in the Culm Measures Natural Area. Otters are dependent on good water quality, 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.

ii) Marsh Fritillary (*Eurodryas aurinia*). This butterfly is classed as Nationally Scarce and has its British stronghold 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 (move to issues?!).

Several other uncommon butterflies and moths depend on the Culm, including Marbled White, Pearl-bordered Fritillary and Narrow-bordered Bee Hawkmoth.

iii) Curlew (*Numenius arquata*). This wading bird has declined to the extent of being proposed for entry in the Red Data Book. 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. Land drainage, drying the soil has a negative effect on these birds.

iv) 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.

v) Kingfisher (*Alcedo atthis*). This species is protected under EU legislation (..ref) and the Wildlife and Countryside Act (1981)(..ref). 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.

vi) 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 which the NRA fully considers during river maintenance work.

vii) 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.

viii) Barn Owl (*Tyto alba*). Although not a true wetland bird, the Barn Owl ought to be mentioned here as the Culm Grassland represents a National stronghold for the 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.

viii) *Cryphaea lamyana* This moss is nationally rare, listed in the Red Data Book. It is found at a couple of locations on the River Tamar. It is a flood zone specialist (ie 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.

Invasive Species

Invasive species, Japanese Knotweed, Himalayan Balsam and Giant Hogweed occur in a number of places within the catchment. Study by the NRA has not conclusively shown that such species generally have a negative impact on native wildlife. However at a localised level there may be problems, including:

- the shading out of native plant species and the prevention of natural regeneration of broadleaved trees;
- increased bank erosion as the invasive plant dies back in Autumn;
- dense stands which restrict access for NRA operational staff and the public.

Under the Wildlife and Countryside Act 1981(..ref) , 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.

The problem has a fairly high public profile in some areas and requires action, by landowners and managers as well as the NRA. The NRA is continuing research into these invasive species and has produced a leaflet "Guidance for the control of invasive plants near watercourses"(..ref) .

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'(..ref), and conversations with County archaeologists and Dartmoor National Park) though the Duchy of Cornwall have carried out an assessment on their holdings.

Within the catchment there are a range of designated sites, though few are closely related to the water environment. Given this it is felt inappropriate that the NRA should be the lead 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. In the catchment as a whole there are 13 SAM Bridges, which are of particular relevance to the NRA, and in addition, Bidlake Mill and Leat, Tamar Canal and Bude Canal Sea Lock are designated 'riverine' SAMs. SAMs are of national importance, protected in law and administered by English Heritage, who the NRA

are obliged to consult if sites are likely to be affected by any developments or operations, directly undertaken or licensed. 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, 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.

Historic Settlements :

There are 2 Historic settlements, Launceston and Lydford, which are designated as being 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 hundreds of 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.

FRESHWATER TAMAR CATCHMENT

Fisheries



4.2 FISHERIES

4.2 FISHERIES

4.2.1 General

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

Areas of concern to the NRA are the impacts on natural fisheries from pollution and decline in water quality, the illegal taking of fish, the escape of non-native species from fish-farms, the impedance of migratory fish and the reduced quality of habitats required to support fish.

The Role and Objectives of the NRA

The NRA aims to maintain, improve and develop fisheries.

The NRA has 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 and sea trout between the sea and their spawning grounds.
- control the movement of and introduction of fish or spawn into any waters other than fish farms.
- control fish disease outside fish farms.
- monitor fish stocks.
- raise income through duties on fishing licences.
- ensure adequate levels of water to support fisheries.

The NRA has a commitment to:

- liaise with other organisations with a role to play in the protection and management of inland and coastal fisheries.
- maintain effective links with local authority planning departments to ensure fisheries are not adversely affected by development plans
- prevent or limit fish losses by the implementation of emergency and rescue policies.
- control the movement or introduction of fish or spawn into fish farms through liaison with 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 fishing (rod and net) catch returns, fish counters, fish traps and routine population surveys 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 the map (Note: they may extend

further but we only mark to where there are records). The most widely distributed non-salmonids are eel, bullhead, 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 each tributary are in Appendix **.

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. Catches vary considerably and there is no obvious long term trend. One factor we have been unable to take into account (through not having the 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.

Grilse (salmon which have only been at sea 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.

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 positively from 1954 to 1988 (current Average 409) due to increased fishing pressure and possibly a larger sea trout run. 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 in the Tamar Estuary. The impact on the freshwater fishery by this activity could be considerable, however the subject will be dealt with fully in the forthcoming Tamar Estuary Catchment Management Plan.

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 were as follows:-

Table : Salmon and Sea trout recorded at Gunnislake Fish counter

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

Relating 1993 rod catch returns of 428 salmon and 281 sea trout to total numbers recorded at the fish counter it is seen that a significant impact is being made by rod fishermen. On salmon particularly this is 12% of returning stock.

Are we able to give an indication of rod fishing impact on returning spring salmon??

Trends in abundance of particular stock components

Since the early 1970's 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. This change may be cyclical in the long term, climate dependant or may be related to high seas fisheries strongly selecting multi-sea winter fish. The outbreak of Ulcerative Dermal Necrosis (UDN) in the early 1970's dramatically affected spring salmon survival. There appears to be a reduction in the incidence of three sea winter salmon and previous spawners caught within the rod fishery.

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.

Spring salmon

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 1960's in both the rod and the net fisheries.

A recent N.R.A. report on Spring fish stocks in the rivers of Devon and Cornwall 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.

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).

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 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 on the River Wolf and River Thrushel has produced records of pumpkinseed, 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.

In order to minimise the risks from introductions checks should be made of all coarse fisheries within the Tamar catchment to prevent further escapes.

Acid Run-off

During the first spate after a period of drought increased acidity in the headwaters of the River Ottery and the River Kensey has resulted in fish kills. An investigation (..ref) has identified the problem to be a natural one, due to the natural geology. Lowered water tables in the drought conditions allow oxidisation of sulphides naturally present in the soil. After the first rain these form acids in the rising water table and enter the surface watercourses, lowering pH.

Obstructions

There are only two impassable obstructions in the Tamar catchment, the dams at Roadford Reservoir (Lyd sub-catchment) and Tamar Lakes (Upper Tamar). All other obstructions are deemed to be passable. However there is some concern over a pipe bridge 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 organised 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) 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.

Bylaws

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

There is no close season for coarse fish in flowing waters or still waters in the Tamar catchment, however proposals for a statutory close season on rivers (but not canals) has recently been accepted by the Minister of Agriculture, Fisheries and Food (M.A.F.F). Within still waters there is no rainbow trout close season.

A new byelaw on the River Tamar has been recently 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"*.

Other future byelaws may include salmon and migratory trout mandatory bag limits, or alternately shortening the fishing season. In addition there may be byelaws created specifically to protect spring fish.

Local Reservoir Operations

Roadford (Operational and Environmental Study)

Construction of Roadford reservoir commenced in 1986 with impoundment in October 1989. (see Section 4.1.) Part of the Roadford storage (227ML) is reserved as a fisheries bank and can be used by the NRA for fisheries purposes to protect fish and encourage migration in the Tamar, Lyd, Thrushel and Wolf in times when natural flows are low.

In addition, an Enhanced Flow Programme has been implemented. This provides for special releases of water during the year to encourage fish migration in the River Wolf, notably for migratory trout. This programme 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 monitoring and investigation work which commenced in 1984. Key elements of this investigation programme are the salmon radio-tracking study, 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) report(ref), in January 1990. A full review of data is planned for 1995.

Studies into sedimentation on the Wolf and Thrushel are ongoing (ref). Work to date shows an increase in smaller particles which are settling out on spawning gravels. (Can this work be applied to upper Tamar operation of the lakes and concretion problem? Even if spawning takes place what about impact on ova and embryo survival...ref Torridge study R+D 152, see also 5.1)

Lower Tamar Lake (Alleviation of Low Flows project)

The Lower Tamar Lake was identified as a low flow area (see section 4.11) 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'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 then artificially hatched and the fish are reared for stocking (as fry, parr and smolts -see glossary) into the Lyd sub-catchment, 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 improvements. Numbers vary according to availability (4,000-20,000 per year)

A National NRA stocking policy is imminent and will supersede current arrangements.

4.3 AGRICULTURE

Over 80% of the land in England and Wales is farmland. 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 river banks can also be a problem. A sustainable farming system that conserves the soil and minimises and recycles wastes will reduce the risk of damage to the water environment.

Our Objectives

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

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
- * 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.

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 inspect 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 things like buffer zones or other schemes to prevent pollution and improve rivers and wetlands for wildlife
- * we educate 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.

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)

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 poached 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 fodder crops and cereal growing for animal feed. The extensive land drainage in the north of the catchment, (around 75% of the land is drained) is perceived to impact on the rivers by causing or exacerbating eutrophication. The clay nature of the soils mean that in the Autumn and Winter no area is more than 50 yards from a watercourse. 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 and the stable soil structure, over shillet, enables 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 having a tendency to occasional floods, 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 problems. The overall cereal acreage has fallen although an increase in winter-sown cereals reflects the higher margins to be gained from such crops.

The farm woodland has doubled in the past ten years mainly due to woodland incentive schemes and grants.

Farm Campaigns and Task Forces have been carried out in the catchment for many years by the NRA and its predecessors. This has resulted in many slurry and silage waste systems being upgraded and pollution events being reduced.

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. 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.

Table 2: 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

Table 3: 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

Table 4: Pollution incidents arising from agricultural activities 1992/3

Pollution Incidents	Major	Significant	Minor
Agricultural			
1992	2	9	77
1993	3	5	55

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

Protection of Groundwater

The NRA published its 'Policy and Practice for the Protection of Groundwater' (PPPG) in December 1992. (.ref) This document contains policy statements on agricultural risks to groundwater including:

The Application of Liquid Effluent, Sludges and Slurry to Land - Policies E1-E5

Risk to groundwater quality is dependent upon the chemical and microbiological content of the waste, the rate, method and timing of application and groundwater vulnerability.

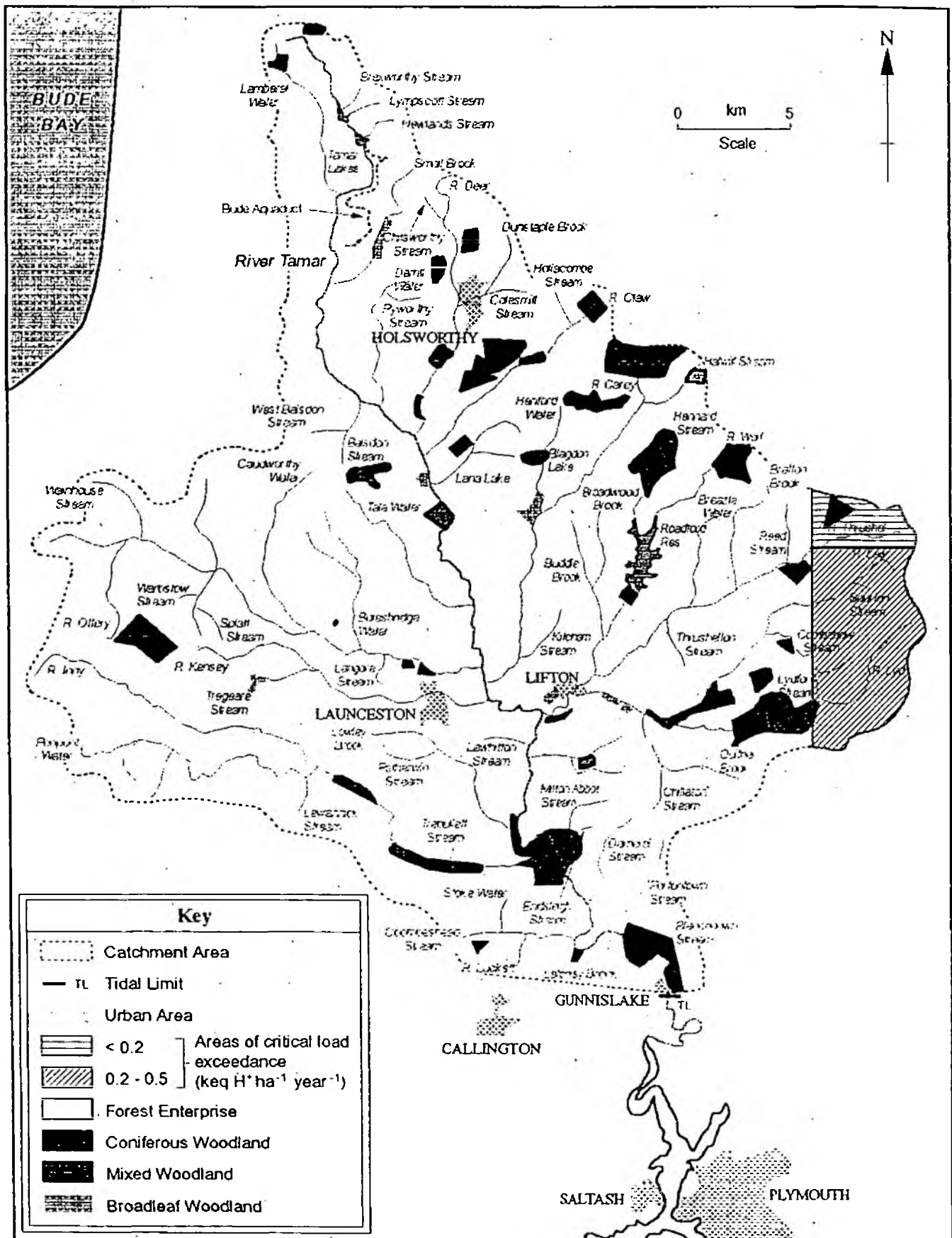
Agricultural Wastes are produced from various farming activities including animal wastes and silage liquors. The NRA will liaise with farmers and seek to encourage them in the preparation of waste management plans for their farms. These should include the drawing up of a map identifying land suitable for the spreading of farm effluent without detriment to groundwater. NRA seeks control through the MAFF Code of Good Agricultural Practice of the Protection of Water. (..ref)

Storage of Farm Wastes and Intensive Livestock Housing - Policy H2

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 (..ref) for all new, substantially enlarged or reconstructed installations. The Code of Good Agricultural Practice for the Protection of Water (MAFF 1991) (..ref) offers guidance generally. The NRA wishes to discourage the establishment of farm waste storage areas and substantial livestock housing within the groundwater Inner Source Protection Zone (Zone 1) unless adequate measures can be agreed to minimise the risk of pollution. (see Section 4.11.3 Groundwater protection) The NRA welcomes discussion on a case by case basis.

FRESHWATER TAMAR CATCHMENT

Forestry



Well managed forestry 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 and Recreation against which all forest operations are assessed. These Guidelines encourages environmentally sympathetic planting through grant aid using the Woodland Grant Scheme.

Objectives

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

The Role of the NRA

The NRA has duties and powers to:

- Regulate some forestry works using land drainage legislation
- Deal with pollution incidents

Further initiatives the NRA is developing include:

Improved 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 an Environmental Statement for significant new planting schemes but the Environmental Assessment Regulations do not apply to felling and restocking which may have effects on the water environment comparable to those of new planting. The NRA nationally will seek improved links with the Forestry Authority to achieve a consistent and effective approach to the environmental assessment of forestry schemes and operations.
- The NRA should be consulted if there is significant planting within the 'main river' floodplain. Formal consent will be required under Land Drainage Bye-Laws. It should be noted that intensive planting in floodplains can result in loss of flood storage which may have an adverse effect on existing flood risks.
- The NRA will continue its liaison with relevant Local Authorities on proposed 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, will also be further developed.

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 *% of the catchment area of which *% is deciduous or mixed woodland. 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.

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 led 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.

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 Forest Authority, which licenses felling, is aware of the problem and advises applicants with reference to 'Forest and Water Guidelines' (...ref)

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

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.

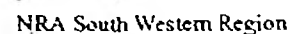
The only identified Critical Load area (where sulphur levels, causing acidification, are considered to be impacting on the ecosystem - see glossary) within the catchment is the extreme east of the catchment on Dartmoor. There is only one large coniferous wood in this area, Thorndon Cross at the head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

Forestry is not considered to impact on total water resources within the catchment. However, there may be increased run off from canopy than other land uses, exaggerating spates and associated problems.

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".(..ref)

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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.

Objective

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:

- * 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 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.

ANGLING

Here we consider fishing with rod and line. For protecting fish stocks see Section 4.2, Fisheries.

Objective

To maintain rivers so that anglers can continue to fish.

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.
- * regulate fishing and raise money for fisheries management by issuing rod licences for freshwater angling.
- * enforce regulations and byelaws to prevent illegal fishing.
- * We are not responsible for sea angling except bass nursery areas, or where the NRA is the Sea Fisheries Committee.

Our work involves a range of activities:

- * we encourage angling and publish leaflets for anglers
- * protect and manage fish stocks with anglers in mind
- * regularly seek the views of Fisheries owners and Angling Bodies.

4.5.1 Local Perspective

Angling

The Tamar and tributaries is a nationally recognised salmonid fishery with angling taking place throughout much of the catchment. The salmon season runs from 1 March to 14 October and that for trout from 3 March (migratory) or 15 March (brown) to 30 September. The fishing rights are owned by fishing clubs and private individuals. Rod catch returns for 1993 (the last year available) were 428 salmon and 281 sea trout. There is no recognised 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

Roadford Reservoir

Since its completion in 1989, Roadford has developed dramatically as a recreational and wildlife site. It provides 730 acres of open water, some of which is 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 becoming one of Britain's major brown trout fisheries. A network of footpaths and bridleways provides recreational opportunities around the shore. A South West Water Ranger Service manages recreation at Roadford.

Tamar Lakes

Upper and Lower Tamar Lakes both have considerable recreational use and wildlife value. Upper Tamar Lake is a stocked rainbow trout fishery. 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. Both Lakes have in the past been affected by blue-green algae blooms.

Sailing takes place on the Upper Lake. Birdwatching takes place around both lakes and the South West Water Ranger Service manages these 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. 30 paddles are permitted at any one time, groups led by senior instructor. The BCU are interested in extending the permission upstream of Greystone Bridge and increasing the maximum number to 40 on one weekend in the year.

The Bude Canal is also used for canoeing along the lower part by activities groups and individuals. Permission is given by Bude Town Council.?? No restrictions on use are known Is it used in tamar catchment.

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 South Petherwin has riverside walks alongside Bolesbridge Water and a bridleway and river crossing at

Tamerton is in the process of 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 to the Gorge to be approximately 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 a '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 and should be supported.

However, the catchment is extremely valuable for otters and mosses, liverworts and lichens and increased access must be carefully managed to be sure that such activity does not disturb the habitats of these rare species.

4.6 AQUACULTURE

Here we consider the use of riverside beds or ponds to rear fish, crayfish or grow watercress. Water is not used up by fish farms but returned to the river close to the point of abstraction.

Objective

To protect rivers from the 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.

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
- * the life-cycle of wild fish in a river can be badly disrupted by the discharge from fish farms. We try to prevent this happening when we approve new licences.
- * we consult fully with Local Planning Authorities on applications for new fish farms.
- * we are looking at ways of regulating fish farming in cages in estuaries.

4.6.1 Local Perspective

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 1989(..ref) had given rise to anomalies that the Group has endeavoured to put right.

There are 3 fishfarms in the Freshwater Tamar catchment including the NRA hatchery at Endsleigh which is used for mitigation work related to Roadford reservoir.

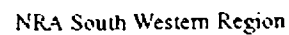
Woodley Fish farm, although it has a provision for residual flow in its licence, has caused the stream to dry up between abstraction and discharge points in low flows.

South Reed Fisheries is primarily a stillwater trout and coarse fishery and farms coarse fish as well as a few rainbows for the table.

Table 4: Fish Farm Abstractions/Discharges

Fishfarm	NGR	Abstraction	Discharge
Endsleigh Hatchery (NRA)	SX 393 783	Spring fed	1136 Ml/day
South Reed Fishery	SX494 912	Spring fed	??
Woodley Fishfarm			

Built Environment



4.7 THE BUILT AND DEVELOPING ENVIRONMENT

The built and developing environment has 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 run-off 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 recognised 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"¹²(.ref) and the Government Planning Policy Guidance. In considering sustainable development policies and strategies, the NRA is keen to promote balanced development, ie 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 1991(.ref) and the Water Resources Act 1991(.ref). 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).

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"(.ref). In order to fulfil 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"(.ref)
- 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"(.ref)

- request the Secretary of State to make regulations under the provision of the Water Resources Act 1991,(.ref) for example the Control of Pollution (Silage, Slurry and Agricultural Fuel Oil) Regulations 1991(.ref) .

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**(.ref), 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**(.ref) which is currently before the Secretary of State for the Environment, will be finalised in the summer of 1994 and predicts a housing increase of 99,000 new dwellings for Devon and 21,700 for Cornwall between the years 1991 and 2011, and 23,200 between 2001 and 2011 for Cornwall.

Part of this total has already been committed in the **Cornwall Structure Plan**(.ref) which runs from 1986 to 2001 and the Third Alteration of the **Devon Structure Plan**(.ref) 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. ~~check~~ 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.

Torridge Landscape Assessment.

The NRA is currently discussing issues with Cornwall County Council for the New Structure Plan, (.ref) Waste Disposal Plan(.ref) and Minerals Local Plan(.ref) We are also involved in the emerging Districts' Local Plans(.ref) 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.

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 is then formally debated and accepted as **Policy**. A list of settlements in the Tamar catchment is given below.

Table : 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.
Sourton	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.

Road Schemes

The NRA is a statutory consultee to the Department of Transport in the process of developing any new trunk roads and inputs into road schemes proposed by County and District Councils.

The NRA are involved throughout the process, from route choice and design to completion of construction and through consultation seeks to protect all potentially impacted aspects of the water environment and secure enhancements.

Particular areas of concern are:

- the proximity of roads to water courses. Roads running alongside watercourses may reduce the conservation and amenity value and provide a continuous threat of pollution through incidents such as road crashes.
- possible pollution during construction.

Road improvements to the A39 at Kilkhampton brush the north west edge of the catchment. The final route option is not yet known but a route east of the town could impact on tributaries of Lamberal Water. The NRA has commented to the highways authority to ensure that safeguards are made during construction and for surface runoff. (Stage 2 consultation - March 1994).

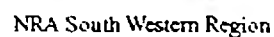
Industry and Tourism

The Tamar catchment is agricultural in nature, Holsworthy and Launceston being the only sizeable towns. 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.

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 throughout the catchments, with focal points 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. Since the Farm Campaigns on the Tamar and the subsequent awareness of pollution problems in the area, these 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.

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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 and in some areas internal drainage boards are responsible for flood defence on ordinary watercourses. Local authorities are also responsible for protecting the coast from erosion by the sea.

We have duties and powers to:

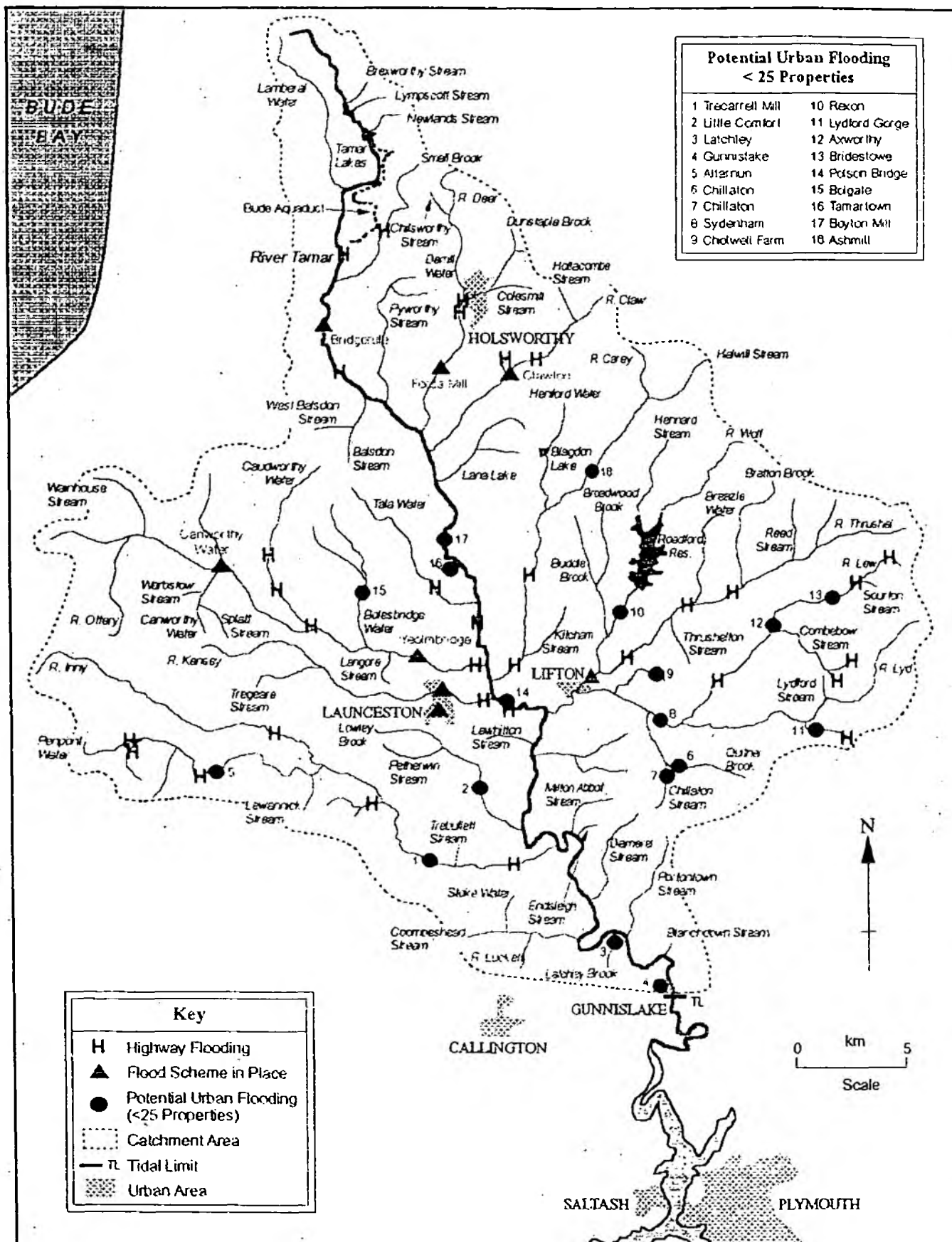
- * control of certain works and advise planning authorities on flood defence;
- * maintain and improve the flood defence system which is under our control.
- * provide flood forecasts and warnings so that risk to life and damage to property is reduced during river and sea floods.

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.

FRESHWATER TAMAR CATCHMENT

Flood Defence



4.8.1 Local Perspective

General

The Tamar catchment is a rural area of scattered communities and market towns. The river systems are well developed with extensive flood plains, 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 the Flood Defence map1.

Regulation

The catchment is largely rural in character and the only development of any size will take place around Launceston, Holsworthy and Lifton/Tinhay. The NRA response to draft local plan proposals (where available) and specific planning applications has been in line with NRA policy and the government circular 'Development and Flood Risk'. (.ref)

The NRA has concerns that sites close to rivers in the Kensey Valley at Launceston and the Lyd Valley at Tinhay will result in loss of flood storage in the flood plain and the consequent increase in flood levels that would ensue if development were to take place (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 run-off (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 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.

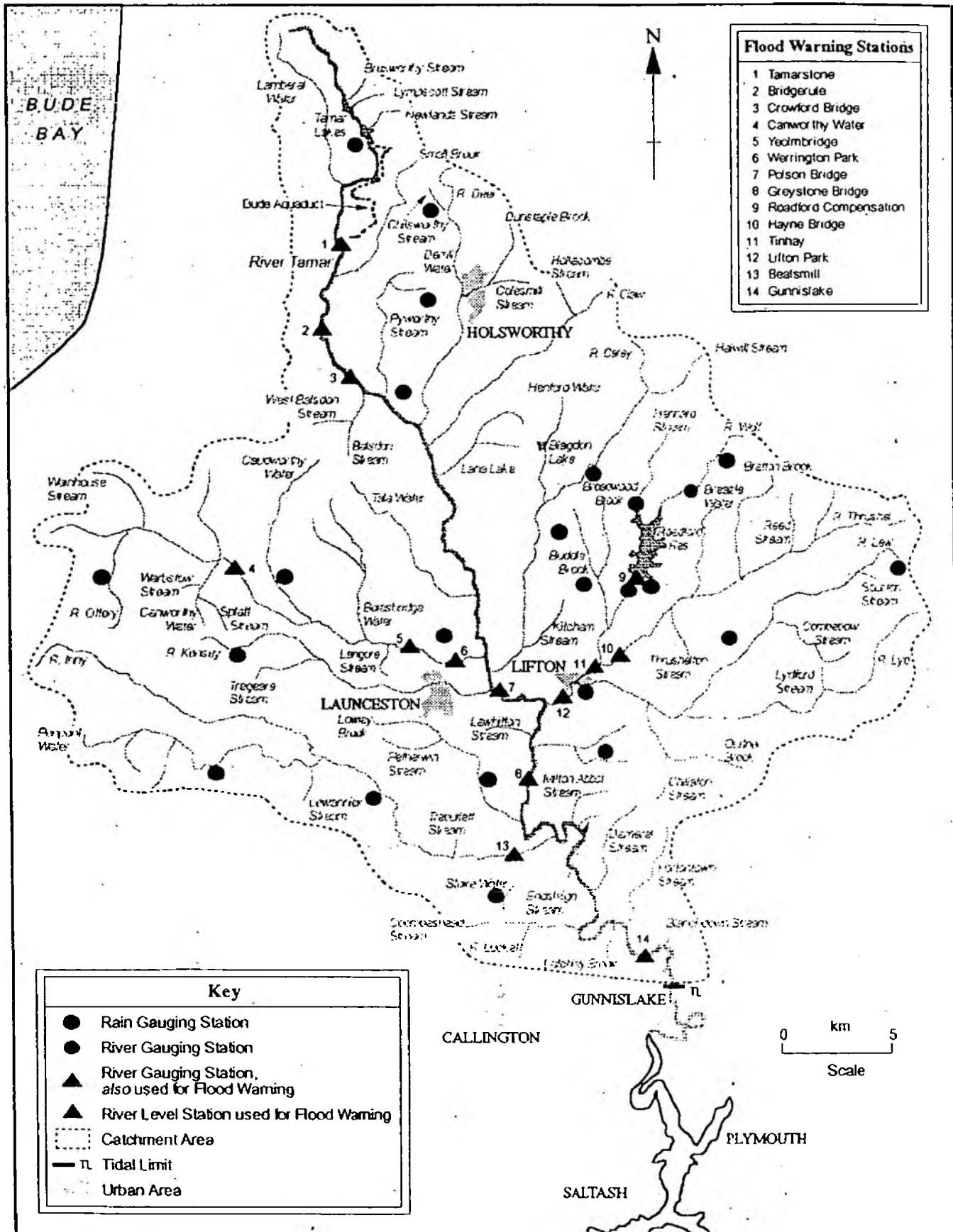
Flooding (see map2)

Historic records show flooding has occurred in a number of locations around the catchment, the bulk of which affect highways or a small number of properties. Most occur on non-main river and are not the responsibility of the NRA, though the NRA does maintain a number of flood defence schemes. To date these have all performed within standard.

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 timescale. The Rivers Ottery and Kensey however receive heavier rainfall and can respond more quickly.

FRESHWATER TAMAR CATCHMENT

Hydrometric Network



Maintenance

Routine maintenance is carried out in a number of locations where there is a NRA flood alleviation scheme (map 2) and includes grass cutting, servicing flapvalves and clearing weed screens. Longer term maintenance such as removal of some shoals and excess vegetation is carried out on a rolling programme of 5 - 10 year period. Work is currently being programmed in line with service level agreements which have been produced for the catchment. These are detailed contracts outlining exactly what work is to be done where and at what frequency.

The public may comment on the detail of these agreements. Due to their size we are unable to incorporate into this plan so copies of the agreements and accompanying maps can be viewed at the NRA office at Sir John Moore House, Bodmin.

Clearance of fallen trees and accumulating debris is undertaken where and when necessary.

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 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).
what about Altamun? Parish Council Letter

Standards of Service text to be added here

Emergency Response

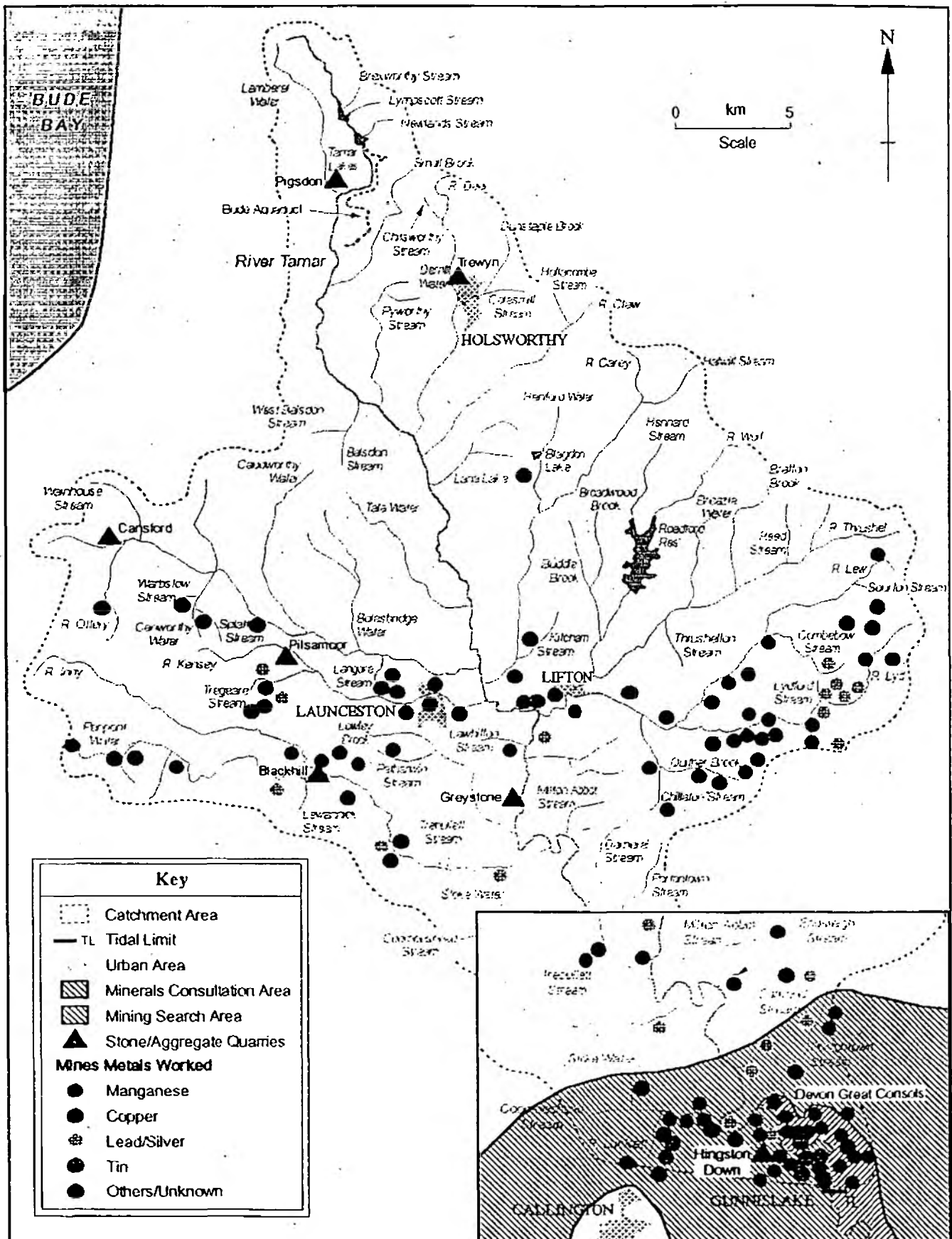
Flood warnings are currently issued from the Regional Office based on weather radar and forecasts and when trigger levels are reached at river gauging stations in the catchments. The gauging stations are shown in the table below. Warnings are colour coded Yellow, Amber or Red to indicate their severity.

Locations of the flood warning stations in the catchment are shown on the Hydrometrics map. Additional sites are planned at Egloskerry on the River Kensey and at Sydenham on the River Lyd.

The emergency workforce respond to incidents as they occur throughout the catchment, there being no special locations where problems invariably arise
what about Bridgerule, St Leonards, Tinhay and other 'blackspots'.

FRESHWATER TAMAR CATCHMENT

Mining and Quarrying



4.9 MINING AND QUARRYING

The NRA recognises 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 can result in the loss of aquifer material and groundwater resources.
- Extraction often involves de-watering, sometimes for substantial periods of time. De-watering can lead to the loss of water supply from wells and boreholes, the removal of natural groundwater discharges to ponds and streams, and can affect wetlands.
- Removal of material from above the water table reduces natural filtration and increases pollution risk to groundwaters.
- There is an increased risk of pollution from plant or operations close to or below the water table.
- • Surface water run-off from spoil heaps and worked areas and discharges from mines and quarries 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.

The Role and Objectives of the NRA

The aim of the NRA is to limit the impact of mining activities on the water environment and promote suitable after use of sites.

The NRA has duties and powers to:

- consent discharges from quarries and operational mines.

Additionally the NRA has a commitment to:

- fulfil its obligations under the Water Resources Act 1991(..ref) through liaison with planning authorities and control through the planning process. The NRA is a statutory consultee for Mineral Local Plans and mining proposals, and an informal consultee on other relevant developments.

In considering proposals, the NRA will have regard to its "Policy and Practice for the Protection of Groundwater" (..ref) which states:

"For any proposals which would physically disturb aquifers, lower groundwater levels, or impede or intercept groundwater flow, the NRA will seek to achieve equivalent protection for water resources and the water environment as if the effect were caused by an abstraction controllable under the Water Resources Act 1991."

The NRA will object to a new proposal for mineral extraction where there will be demonstrable harm to water resources and the water environment, unless measures to mitigate any effects can be agreed within planning controls.

The NRA will normally object to proposals where the obstruction of groundwater flow is likely to cause undesirably high groundwater levels or cut-off groundwater flow, unless measures to mitigate any effects can be agreed.

encourage best practice regarding the backfilling of any abandoned shaft, well, borehole, tunnel or adit in order to prevent pollution or loss of water resources.

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 is currently engaged on the 'Mines Database' project, set up to compile a comprehensive database on mines, adits and associated infrastructure. With detailed information on the nature and drainage of specific workings it is an attempt to be more pro-active and forward plan for potential impacts on the water environment. Surveying of the internal workings of old mines is impracticable. Currently the project has covered Devon and part of Cornwall, including the Tamar catchment. Information has been gathered largely as a desktop exercise and, 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 result in ground truthing and adding to existing data.

Similar work is being carried out by Caradon District Council 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, 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.

Mining Impact on the Catchment

The area is honeycombed with old shafts and adits. The presence of underground mine workings and drainage adits has a significant effect on the local groundwater flow direction and discharge points. Any collapse or blockage within the mine system may alter flow paths, discharge points and toxicity of water.

The shaft caps and internal mine structures are now reaching the end of their useful life 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 Lower Tamar are considered to arise from the drainage of old mines and adits in the Gunnislake area. The problems are identified in the water quality 'state of the catchment' section (5.1).

Most of the spoil heaps and adits have been abandoned for about 100 years and have stabilised and are re-vegetating. Proposals that involve disturbing the ground will have an adverse impact on water quality in the watercourses.

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. The only sites that are known to caused pollution problems are Hingston and Cansford, although in the latter case it is surface runoff arising from cement works situated within the quarry site that causes problems rather than the quarrying. Hingston Quarry is situated in an area of historic mining activity and will cut through to old mine workings in the near future. An investigation by the NRA (.ref) has found that the Hingston discharge does not significantly add to the concentration of metals in the Lower Tamar caused by mine drainage.

The County Councils, in their Mineral Plans, (.ref) 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. 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 we take action we have to be sure that what we recommend (which can be very costly) will have worthwhile and lasting benefits. We can do a range of things to help tackle the problem. Planning Authorities also have powers that they can use. Here are some of the things we can do:

- * 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 targeted for redevelopment and clean up plans prepared
- * prosecute the owner of contaminated land if they cause pollution.

Groundwater Pollution Risks from Contaminated Land

Pollution risks to groundwater can occur from derelict land in a contaminated state or 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 has produced 'Policy and Practice for the Protection of Groundwaters' (PPPG) (.ref) which includes policies on contaminated land. The NRA has representation in the Planning process to control pollution risks from contaminated land. (see also Section 4.11.3 Groundwater protection)

4.10.1 Local Perspective

Historic development within the catchment has undoubtedly left areas of contaminated land, most obviously in areas of mineral extraction and ancillary industries. Impact on the water environment is currently being experienced in high metal levels in the Lower Tamar. Due to the extensive nature of mineral workings diffuse sources (not all logged) are contributing to the problem. As levels are not at a point to threaten public health and there is no identified solution for a short term project to bring long term cure no NRA expenditure or work is planned within the catchment in the short term.

The Regional Mines Database project is attempting to catalogue areas involved in mineral extraction so that:

- when site specific redevelopment applications are made the problem is not exacerbated, or indeed may be improved;
- when further resources are available particularly problematic sites, or types of site can be targeted;
- if continuing research generates applicable solutions, sites, or types of site, can be targeted.

Caradon District Council is currently engaged in 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 proper prior investigation. The NRA is liaising with Caradon over the database and will consult on individual planning applications to seek to protect and enhance the water environment.

Experience gained with investigation of contaminated land sites shows that locally groundwater pollution can often be expected in the vicinity of gas works sites, landfills, manufacturing plant, old underground fuel storage tanks, industrial estates and mines. While not generally documented such pollution is undoubtedly present locally at many sites within the Tamar catchment. The overall proportion of groundwaters affected is however likely to be small.

Historic mining activity in the lower Tamar Valley has left a legacy of toxic spoil tips and associated works all around the Gunnislake area (see Mining map). Greenhill Works near Chilsworthy and Devon Great Consols were sites of arsenic works. Re-vegetation of these two sites is sparse reflecting their toxic nature. The potential for pollution of water courses will be exacerbated if the tips are disturbed.

General Development Order allowing removal of waste by locals

Planning permission was granted in 1990 for 1 tonne of arsenic sand to be removed annually from metalliferous mine tailing tips at Devon Great Consols for 5 years. Conditions have been put on the permission to minimise disturbance of the most sensitive areas near the river.

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.

In 1989 Wardell Armstrong carried out a survey on the pollution risks from mine waste tips in the Gunnislake area. (..ref) This was undertaken by considering the pollution risks of 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' 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). Several spoil tips, or combinations of spoil tips, were assessed as 'high' or 'very high' risk.

'Very High' risk: Gunnislake Clitters mine

 Wheal Anna Maria

 Bedford United mine

'High' risk: Wheal Maria and Wheal Fanny group

 North Dimson

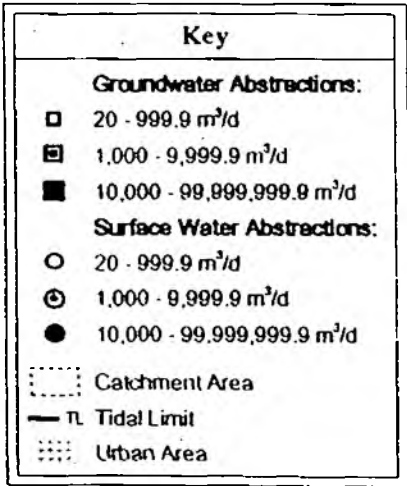
Two types of pollution risk were identified;

- 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 recommendations of the report were that the tips should be left undisturbed, by

restricting access and removal of material and by careful felling in the adjacent woodland. Remedial work to improve water quality would consist on a combination of interception of tip runoff/drainage and modifications to the slope, covering surface and revegetation to stabilise the tips. These solutions are expensive and need to be studied in context with wider issues such as the ultimate land use.

Abstractions



4.11 ABSTRACTION AND WATER SUPPLY

Here we consider 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 achieve the right balance between the needs of the environment and those of the abstractors.

The Role of the NRA

Our management of water resources is guided by European Union and UK legislation. We have duties and powers to:

- * ensure water is used properly, regulating abstractions using licences
- * conserve water supplies and protect them from pollution or over use.

Our work involves a range of activities:

- * we plan for the sustainable development of water resources, developing criteria to assess the reasonable needs of abstractors and the environment
- * we 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
- * we are working on a system for mapping the availability of groundwater
- * we are studying rivers stressed by abstraction, reviewing how we can limit the environmental effects - for example "minimum acceptable flows"
- * we are developing and implementing a consistent approach to determining licences
- * we are working on ways of setting Environmental Quality Standards to help us determine licences
- * we promote selective domestic metering where resources are stressed
- * we define source protection zones to protect resources from development and pollution risks.

4.11.1 Local Perspective

Current licensed abstractions

In the Tamar catchment there are 24 licensed surface water and 459 licensed groundwater abstractions. The authorised annual total of water which can be abstracted from the catchment is 171,478Ml/year, 170,563Ml from surface waters and 915Ml from groundwater sources.

Abstractions for public water (potable) supply (South West Water Services Limited) and abstractions for private water supply (general agriculture, spray irrigation, fish farming and industry/commerce) can be considered separately.

Public water supply

Supply for potable water is made by South West Water Services Limited (SWWSL). The company holds 4 surface water abstraction licences in the Tamar catchment with an annual authorised total of 86,524Ml/year. This represents 50% of the annual licensed total for the whole Tamar catchment. SWWSL holds no groundwater licences in the catchment.

These abstractions are viewed as total losses to the Tamar catchment.

Abstraction from the Tamar catchment by SWWSL is dominated by the Roadford Strategic Supply System. The Upper Tamar Lakes Scheme supplies water locally and an abstraction on the Witheybrook at Bastreet in the Lynher catchment supplies the Launceston area.

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Roadford Strategic Supply System

Roadford Reservoir 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 (see map). The zone is served by a complex water resource system containing 3 reservoirs (Roadford, Meldon and Burrator) and river abstractions from 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. Descriptions of Roadford Zone sources outside the catchment are in Appendix G.

Essentially, during wet periods water is abstracted directly from natural river sources and smaller reservoirs whilst during drier periods these abstractions are reduced or cease altogether and water stored in Roadford Reservoir is used.

The calculation of the reliable yield for the Roadford Strategic Supply Zone is complex, however, the latest data (presented in the NRA's Regional Water Resources Development Strategy (..ref)) shows that the total reliable resource available during a drought would be 326 MI/d. It should be noted that this figure includes yields for the Roadford Supply System sources in total.

Modelling work by the NRA over the next 12 months will provide an audit of the estimate of the reliable resource available during a drought.

Comparing the reliable yield to current demand figures shows that the Roadford Supply Zone currently has a surplus of 80MI/d. This reflects the fact that the Roadford Reservoir has been designed to meet demand in the early 21st century.

Roadford Reservoir

Roadford Reservoir on the River Wolf is the centrepiece of the Roadford Strategic Supply system. Construction was started in 1986 and the dam was completed in October 1989 when filling of the reservoir began. 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/d (29,747.5MI/yr) can be taken for supply to North Devon and a maximum of 148MI/d can be released as augmentation for abstraction at Gunnislake. A compensation flow of 9MI/d is released into the Wolf throughout the year.

Part of the Roadford storage (2273MI) 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. This provides for special releases of water during the year to encourage fish migration in the River Wolf, notably for migratory trout. This programme effectively makes use of the surplus water in the reservoir which is available during the early years of the scheme.

Gunnislake River Abstraction

This abstraction is located just upstream of the A390 bridge, near the tidal limit. The abstraction operates both as an unsupported and a supported source, governed by a prescribed flow condition. Under the current licence SWWSL may abstract 50% of the excess above the prescribed flow (as well as any water released from Roadford), up to a licensed limit of 148MI/d (54,020MI/year). Below the prescribed flow, 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 supply to the city. In addition, water can be pumped into a transfer main which conveys raw water across South Devon to Littlehempston WTW near Totnes, in the Dart catchment.

Tamar Lakes Scheme

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. However, only the Upper Lake is now used for public water supply. The Upper Lake has a capacity of 1,335Ml and water (up to a licensed maximum of 9.09Ml/d, 2,295.76Ml/yr) is abstracted direct for processing at Tamar Lakes WTW before supply to the local area. A compensation release of 2.76Ml/d must be released from the Lake at all times.

The reliable resource available during a drought is 6.3Ml/d (NRA Regional Water Resources Development Strategy(..ref)).

Private water supply

In a rural area such as the Freshwater Tamar catchment many 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. The largest number of licences are for agriculture reflecting the importance of this activity in the catchment. Many of these abstractions are licensed for small volumes or are exempt from licensing (less than 20m³/day).

Industrial/commercial abstractions include two creameries (at Lifton and Davidstow) and quarries. Most businesses obtain their water supply from the mains.

The table below shows the breakdown of numbers and quantities of abstractions by use

Table **: Nett Private Resource Commitment in the Tamar catchment

Type of Abstraction	Ground or Surface water	Number of licences	Quantity m ³ /year	Proportion of abstraction not returned
Agriculture	Ground	438	623783	25%
	Surface	3	231595	(30 in SW)
Spray Irrigation	Ground	1	1818	100%
	Surface	1	91	.
Pisciculture	Ground	0	0	0%
	Surface	5	888781	
Private water undertaking	Ground	55	45294	25%
	Surface	0	0	
Hydropower	Ground	0	0	0%
	Surface	8	81315539	

Type of Abstraction	Ground or Surface water	Number of licences	Quantity m ³ /year	Proportion of abstraction not returned
Industrial processing and cooling	Ground	7	258655	30%
	Surface	6	1603760	

Future demand

The options to meet future demand of water are discussed in Section 5.2 (Water quantity Targets and Current State).

Low Flow Sites

In 1990 the NRA South West Region commissioned Sir William Halcrow and Partners to produce a report identifying the problems caused by artificially low river flows within the region. Four low flow sites were identified in the Tamar catchment;

Lower Tamar Lake

This is a 40 acre lake in the upper reaches of the Tamar which receives spill and compensation releases from Upper Tamar Lake. The Lake is operated by SWWSL for sport fishing and conservation interests.

The NRA is concerned about reduced flows in the river below Lower Tamar Lake having environmental impact and is currently monitoring juvenile salmonid production. (see Section 4.2.2 Fisheries).

see Alan Weston to obtain NRA position/status of work

Trecarrell Mill

Trecarrell Mill - to come (from Sheila Turner)

Woodley Stream

A fishfarm which has the potential to dry up a stretch of the stream between its abstraction and discharge points. Currently no such impact occurs.

Gunnislake

Between New Bridge and the Weir the SWWSL abstraction was noted as having an impact, reducing flows and causing small algal problems.

Licences of Entitlement (LoEs)

Prior to the Water Act 1989 (ref) certain types of abstraction were exempt from requiring a licence. This generally applied to abstractions for domestic and agricultural related activities, including the keeping and breeding of fish.

Abstractors in these categories taking more than 20m³/day were entitled, by virtue of provisions contained in the Water Act 1989, to apply for a licence. In order to qualify, applicants had to establish to the reasonable satisfaction of the NRA that the previously exempt abstraction had taken place from a source of supply at any time within the preceding five year period ending on 1 September 1990 - the transfer date.

The terms of the licence to which applicants were entitled were based on certain statutory criteria which reflected the abstraction regime that existed during the qualifying period. No opportunity was afforded to the NRA to introduce any controls on these abstractions other than to embody the existing abstraction regime in the licence. Any subsequent

variations to these licences will enable the NRA to apply its normal protection standards. Wherever possible, the NRA endeavoured to reach voluntary agreements with the applicants to include measures for the protection of resources. A licence, once issued, can normally only be revoked or varied by the NRA if the applicant agrees or is compensated for any loss or damage arising.

6 LoEs were issued within the catchment. All either have a prescribed flow condition in the licence or an agreement with the landowner not to take the entire flow of the watercourse concerned.

4.11.3 Groundwater Protection

A key objective of the NRA is to protect groundwater from all types of threat, large and small, from point and non-point (diffuse) origins, and by both persistent and degradable pollutants. 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. (ref)

The PPPG contains policy statements on the following aspects of groundwater protection:

- Control of Groundwater Abstractions
- Physical disturbance of aquifers (water bearing rocks) affecting quality and quantity
- Waste disposal to land
- Contaminated land
- Disposal of sludges and slurries to land
- Discharges to underground rocks
- Non-point (Diffuse) pollution
- Unacceptable activities in the inner protection zone (see below)

The PPPG sets out the framework for assessing risks and provides guidance in terms of policy statements and Acceptability Matrices regarding various activities. 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 groundwater used for public water supply.

The NRA is engaged in a national programme of designating Source Protection Zones within catchment areas feeding public groundwater supplies 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 with 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 being established, we are also defining Source Consultation Zones within which we will seek referral of particular development activities to assess source protection requirements.

There are no public groundwater supplies in the Tamar catchment.

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 development conform to PPPG.

Outlined below 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.

Control of Groundwater Abstractions - Policy A1

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 Authorizations under Water Resources Act (WRA) 1991. ..ref

Physical Disturbance of Aquifers and Groundwater Flow - Policies B1-B4

Effects on water resources from proposals that physically disturb aquifers, lower groundwater levels, impede or intercept groundwater flow eg 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. Controls through NRA representation in the Planning process.

Diffuse Pollution of Groundwater - Policies G1-G4

Groundwater contamination arising through areal spread of pollutants eg nitrates/pesticides, and cumulative effects of many individual events eg farm wastes or industrial solvent spillages. Controls possible under Sections 93 and 94 of Water Resources Act 1991 (..ref) Also Discharge Consents Controls, and Regulations (Section 92) of WRA 1991 eg Silage, Slurry and Agricultural Fuel Oil Regulations 1991. (..ref)

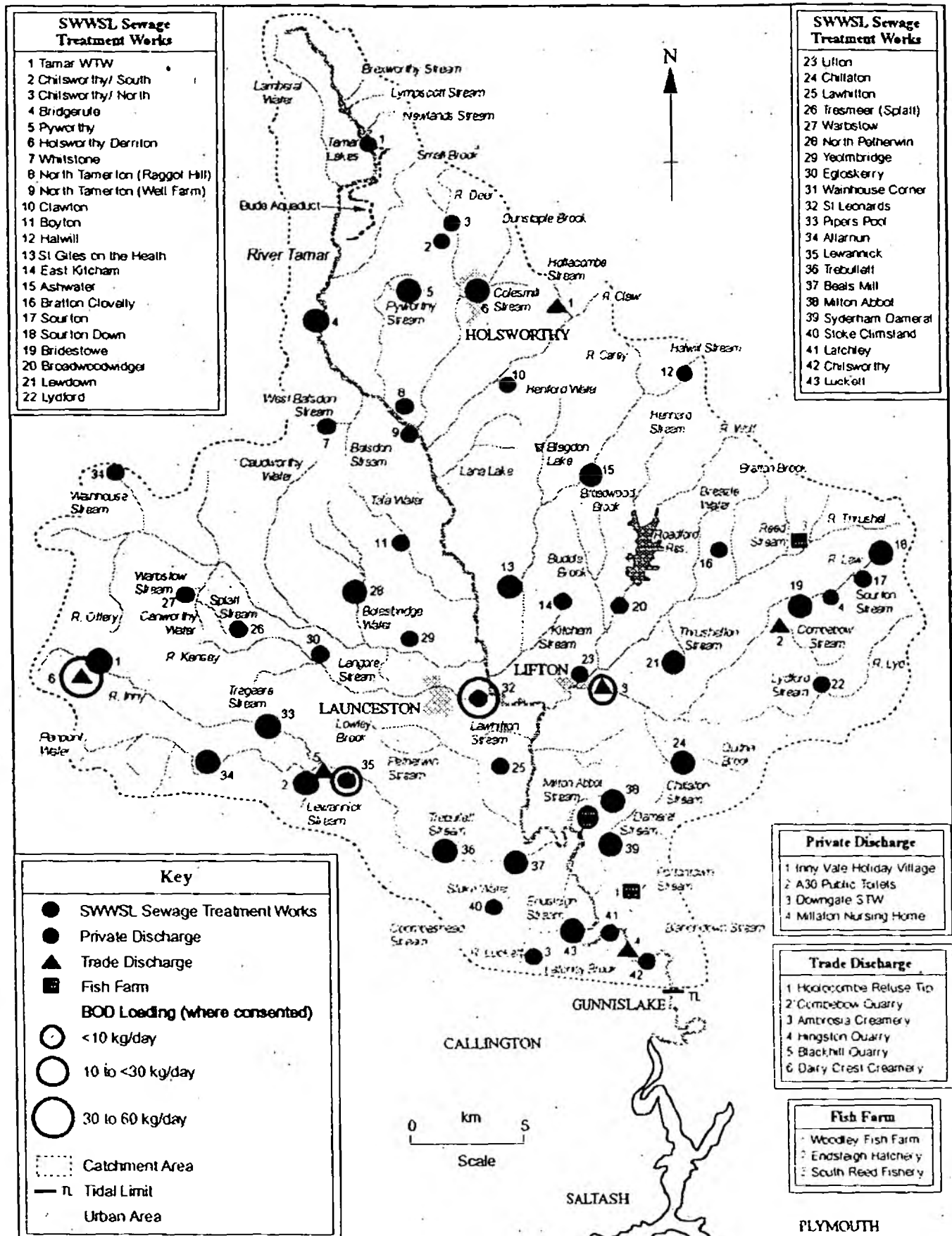
Additional Threats. Production, Storage and Use of Chemicals (Raw and Waste) - Policy H1

Point source risk to groundwater quality. Controls through NRA representation in the process planning. Normally NRA will object to proposals within Zones 1 and 2. Storage of waste may require a Waste Disposal Licence (NRA Statutory Consultee).

The ways in which guidance from PPPG impacts on various catchment uses can be found in their respective sections (Agriculture, Contaminated Land, Effluent Disposal and Waste Disposal).

FRESHWATER TAMAR CATCHMENT

Effluent Discharges



4.12 EFFLUENT DISPOSAL

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

Rivers breakdown most types of pollution naturally. With proper controls the environment will not be harmed.

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:

- * license discharges through a system of consents. We must issue a consent to discharge unless there is a good reason to refuse it. We look at the circumstances in each case. If a river is already badly polluted or if an effluent is of poor quality we can refuse a consent.
- * check discharges to see if they comply with standards. We may prosecute dischargers if they break consent conditions.
- * prevent illegal discharges.
- * work with OFWAT to direct investment in sewage treatment by the water companies.

We are involved in a range of activities:

- * we work with planning authorities to control development where the sewerage treatment system is overloaded.
- * we liaise with trade dischargers, farmers and South West Water Services Ltd carrying out regular site inspections.
- * we constantly review and develop our approach to water sampling

Sewage Treatment Funding Plans

Improvements to South West Water Services Ltd. STWs over the next ten to fifteen years can only be carried out if money is available. OFWAT (the government water company regulator) decides where and when this money is spent. We help OFWAT to set these priorities and agree spending plans - known as AMP2 Plans - with the water services companies. In priority sequence, AMP2 includes:

- 1 Schemes required to meet current legal obligations
- 2 Schemes required to meet future legal obligations
- 3 Schemes which have been separately justified to maintain river quality relative to the 1990 survey or to achieve river or marine improvements.

Strategic Business Plans were submitted in early 1994 and OFWAT declared the associated charging base in July 1994. However no commitment to the delivery of the environmental

programme can be given by SWWSL until their request for an assessment by the Mergers and Monopolies Commission (MMC) is completed. It should be emphasised therefore that improvements identified for the catchment under AMP2 are provisional until a financial commitment is established.

The timing of any improvement works will depend on a priority rating system agreed between SWWSL and the NRA. Details of individual works will not be known until the MMC assessment is completed.

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 run-off, and pollution incidents, such as accidental spillages, cannot be controlled by discharge consents.

Three types of consented discharges are found in the catchment:

- **Continuous;** from sewage and trade wastes.
- **Intermittent;** from storm sewer overflows and emergency overflows.
- **Discharges to Ground;** into soakaways in the ground.

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

Table : Percentage of Population on mains sewerage

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

As can be seen there are, and will continue to be significant proportion of private discharges.

The regional policy is to discourage the proliferation of small private treatment plants in favour of mains connections.

(Note: OFWAT prescribed a £200.00 connection fee from 1995/6)

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

There are currently 11 NRA recommended areas of development constraint (see Section 4.7.3) throughout the catchment based on sewage treatment works (STWs) which are not complying with their consents, are having an environmental impact on receiving waters or are causing failures of EC directives. Development Restraints are representations by the NRA to Planning Authorities to prevent development which would require connections to mains sewerage systems where this would exacerbate an existing problem.

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.

Neither Launceston St Leonards or Holsworthy Derriton are consented for HCH, a List 1 substance, but both are discharging the substance to the receiving watercourse. SWWSL must review the trade effluents coming into their treatment works and take action to prevent further non-compliance. (see Section 5.1)

There are 4 private sewage treatment works consents, none of which is of significant volume and 8 trade consents consisting of 3 quarries, 2 fishfarms and 3 creameries.

Consent failures have occurred at 3 sewage treatment works, a creamery and a private treatment works in the year to the end of June 1994.

Stoke Climsland STW

Pipers Pool STW

Sourton Down STW

Dairy Crest Creamery, Davidstow

Inny Vale Holiday Village

*The consent at Ashwater is currently being reviewed.
check with 5.1*

Intermittent Discharges

Four Storm Sewer Overflows in the catchment have caused aesthetic problems.

Discharges to Ground

Some discharges are made into soakaways in the ground. Here, the NRA's "Policy and Practice for the Protection of Groundwater" (..ref) is applied to protect groundwaters and water supplies. Controlled Waste (industrial effluent sludges, both organic and inorganic in nature and including septic tanks and cesspool contents) is controlled through consultation with Waste Regulation Authority on the Registration of Exemptions under the Environmental Protection Act 1990. (..ref)

Sewage Sludge, produced exclusively at sewage works and disposed of by sewerage undertakers or their contractors, is controlled through consultation with Statutory Undertakers and NRA. HMIP is the competent Authority for the Sludge (Use in Agriculture) Regulations 1989. (..ref)

Discharges to Underground Strata

Groundwater quality is protected by NRA control of discharges under the Water Resources Act 1991 (..ref) through consenting or prohibiting discharges to groundwater either direct or via a soakaway. No discharge of List 1 substances to underground strata is consented. Domestic sewage effluent in a groundwater protection Zone 1 must be discharged into a sealed effluent storage tank in the absence of main sewer. (see Section 4.11.3 for description of groundwater protection zones)

Discharges of sewage effluent to groundwater from new septic tanks or STWs greater than 5m³/d will be controlled. Discharges under 5m³/d will be controlled when groundwater judged at risk.

The geology of the Upper Tamar ??? any probs.

Septic tanks in villages at top of catchment - soakaways close together.

Pollution Events

Table : Pollution incidents arising from industrial and sewage effluents 1992/3.

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

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

Urban Waste Water Treatment Directive

Altarnun STW and Lewannick STW are identified under AMP2 as requiring appropriate treatment under UWWTD. Both works require secondary treatment by 2005.

Future

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.

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.

Some 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
- * prosecute offenders if pollution is caused

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
- * we try to ensure that site operators monitor water and try to prevent pollution if they are applying for a new site licence.
- * We help to make sure that sites are maintained and operated properly.
- * we encourage waste minimisation and recycling.

Groundwater Pollution Risks

Pollution risks to groundwater can occur from landfill and other waste related activities including, incinerators, transfer stations, civic amenity sites, waste chemical treatment plants, storage of special wastes and scrapyards. The NRA can control such risks as a statutory consultee to Planning and Waste Regulation Authority. (see also Section 4.11.3, Groundwater protection)

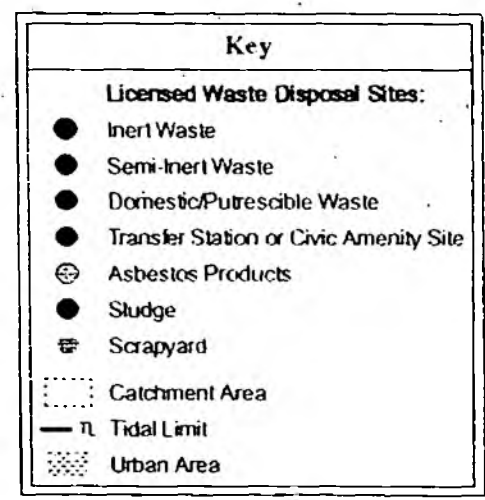
4.13.1 Local Perspective

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.

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

Waste Disposal

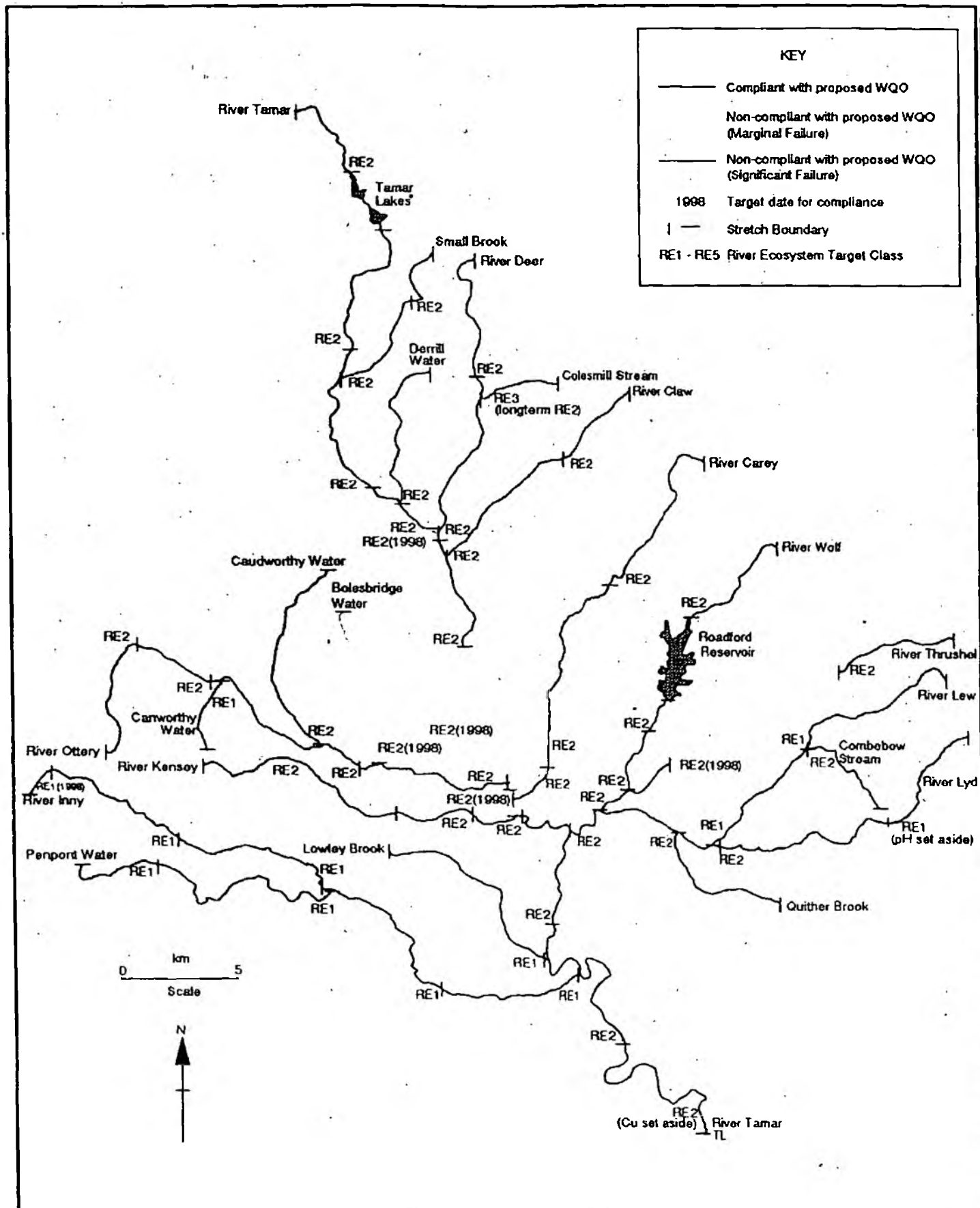


is moved to the lined eastern side of the site the ammonia in the spring is reduced.

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

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

**Tamar Catchment
1993 Compliance with Water Quality Objectives
River Ecosystem Classification**



5 TARGETS AND CURRENT STATE

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 recognised 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 recognised 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 Class 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.

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*. 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 ***) are based on the chemical water quality requirements of different types of ecosystem, and consequently the types of fisheries they are capable of supporting.

"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" 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 ***. It is proposed that these WQOs will apply from 1995, initially on a non-statutory basis.

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:

River Tamar: Below confluence with River Deer
Netherbridge
Polson Bridge

River Inny: Upstream of Davidstow Creamery

River Thrushel: Stowford Bridge

Bolesbridge Water: 200 m D/S of Navarino Bridge
Ottery Confluence (inferred stretch)

Certain stretches are achieving water quality which is better than their previous 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 RQOs have been set for the following stretches:

Lowley Brook: Lowley Bridge
Tamar Confluence (inferred stretch)

River Inny: Upstream of Davidstow Creamery
Trecarrell Bridge
Beals Mill Bridge
Tamar Confluence (inferred stretch)

River Lyd: A386 Roadbridge Lydford

Quither Brook: Prior to River Lyd
Lyd Confluence (inferred stretch)

Lew (Tamar): Combebow Bridge

Prior to River Lyd
Lyd Confluence (inferred stretch)

Canworthy Water: Prior to River Ottery
Ottery Confluence (inferred stretch)

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, but for which investment is not available to bring about improvements (i.e. current water quality does not match the long term WQO and there is no date for when compliance must be achieved). Long term WQOs of RE Class 2 have been set for the following stretches:

Colesmill Stream: 100 m D/S of Holsworthy STW
Deer confluence (inferred stretch)

There is one stretch on the River Carey, Ashmill Bridge, where a WQO of RE 2 has been set which represents a downgrading compared to the old RQO. The WQO has been set at RE 2 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 RE 2 which is consistent with their RQOs.

Current State of the Tamar Catchment

An assessment of current water quality based on the River Ecosystem use classes (Appendix ***) 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 ***.

Compliance is expressed in terms of significant and marginal failures. Significant failures are those where there is 95 % confidence that the river stretch has failed its WQO.

Marginal failures are those where there is at least 50 % confidence, but less than 95 % confidence, that the river stretch has failed its WQO.

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 below. In addition, those stretches where pH or copper data are "set aside" are also identified.

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.

Issue 1: Marginal non-compliance with WQO due to agricultural activity.

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 influenced by past mining activity. If the copper data is "set aside" then the stretch achieves its WQO of RE Class 2.

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

River Inny

The stretch Upstream of Davidstow 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 has resulted in an improvement in water quality for 1994. This means that the stretch should be compliant with its WQO of RE 1 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 arises on Dartmoor this low pH is attributed to naturally occurring acidic run-off. If the pH data is set aside then this stretch achieves its WQO of RE Class 1.

See Issue 2.

To Go?

The stretch of the River Lyd monitored at Greenlanes Bridge marginally fails to comply with its WQO of RE Class 1 due to elevated levels of BOD which is thought to be due to farm run-off. However, the target date for compliance with the WQO is not until 1998.

See Issue 1.

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 run-off during periods of high rainfall. However, the target date for compliance with the WQO is not until 1998.

See Issue 1.

To Go??

River Kensey

The River Kensey at Truscott Bridge marginally fails to comply with its WQO of RE Class 1 as a result of elevated concentrations of BOD and total ammonia. This is thought to be due to agricultural run-off during times of high rainfall. 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 run-off at times of high rainfall. However, the target date for compliance with the WQO is not until 1998.

See Issue 1.

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 Directive) for metals are not met due to inputs from natural sources the NRA will recommend a derogation, i.e. 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/EEC, 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 ***).

The designation of river stretches and lakes is shown on the map ***. 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 sites except at 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.

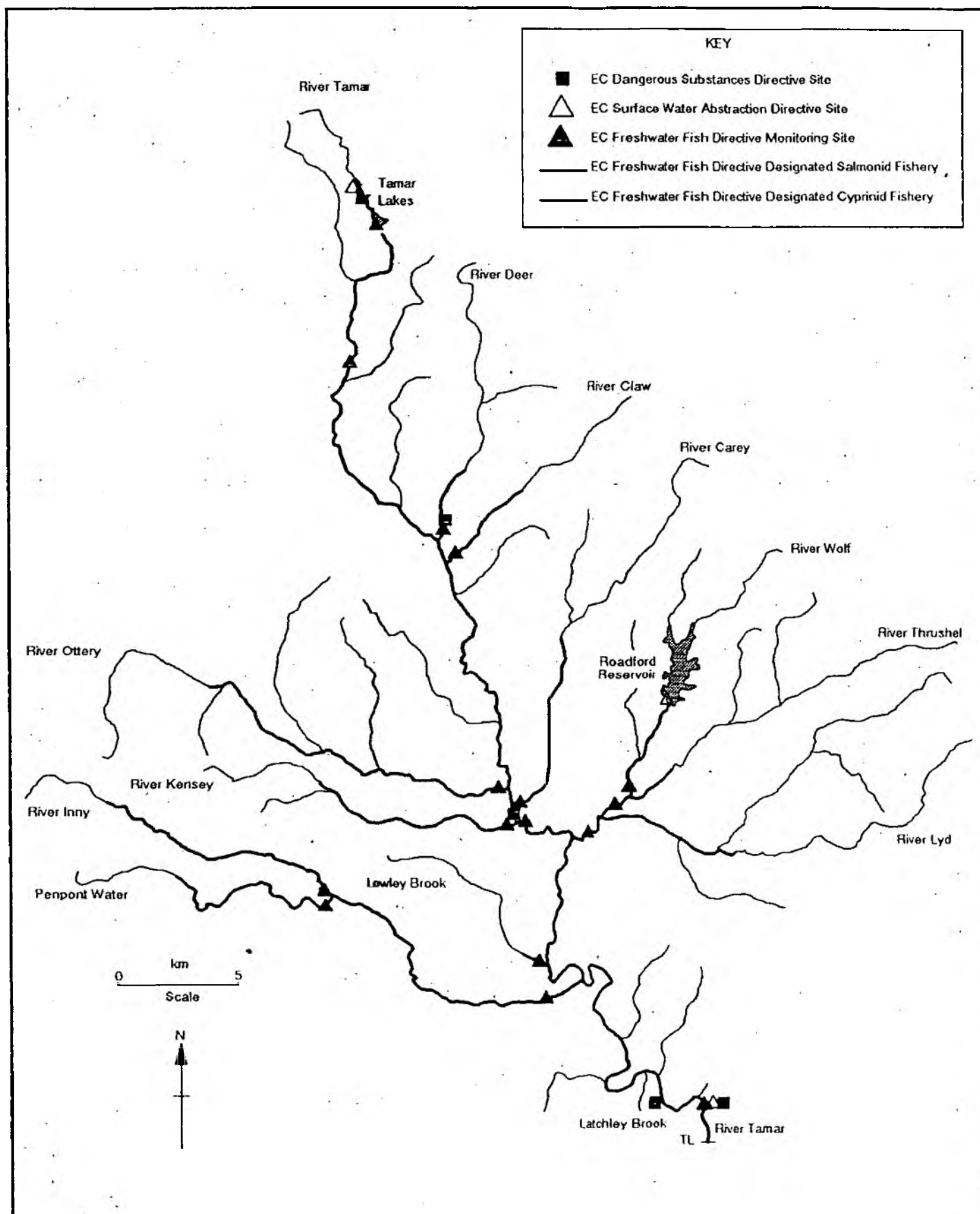
See Issue 2.

EC Dangerous Substances Directive

The Dangerous Substances Directive "on pollution caused by certain substances discharged in the aquatic environment of the community", 76/464/EEC, 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 ***). 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 ***).

The sites monitored in this Catchment are shown on the map ***. 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. HCH is monitored in the sediment downstream of these two STWs. List II substances are monitored in the River Tamar downstream of Hingston Quarry.

Tamar Catchment EC Directives



Current state

The Environmental Quality Standards (EQSs) for List I Dangerous Substances have been met at all sites monitored in the catchment since 1991. Gamma HCH increased in sediments downstream of both St Leonards STW and Holsworthy (Derriton New) STW from 1991 to 1992. In 1993 reporting procedures changed and Total HCH was reported for these sites; however from 1992 to 1993 gamma HCH increased in the sediment downstream of St Leonards STW, but decreased downstream of Holsworthy STW.

Issue 3: Increase in gamma HCH downstream of St Leonards STW and Holsworthy (Derriton New) STW from 1991 to 1992.

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. In the reach from Gunnislake Gauging Station to the old level upstream of Hingston Quarry discharge several significant point and diffuse sources of dissolved copper were identified. These were from the abandoned mine workings and spoil tips adjacent to the discharge, particularly Clitters Adit, which contributes about 40% of dry weather loading of dissolved copper into the river (Hingston Quarry discharge contributed 2%). 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 and recommendations of the NRA investigations included relocation of the sampling point to Gunnislake Gauging Station to ensure full mixing of the quarry discharge. The exceedance of dissolved copper at the sampling point cannot be attributed solely to Hingston Quarry discharge but to a combination of local geology and historical mining activity in the area, causing 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 1990, commissioned by the then South West Water Authority, recommended that the tips were left undisturbed (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), 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 ***).

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 ***

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. The apparent exceedences for phenol were due to

the statistical method used to interpret data recorded below the limit of detection, and the exceedence for dissolved and emulsified hydrocarbons was thought to be due to a problem with analytical methodology.

EC Urban Waste Water Treatment Directive (UWWTD)

The EC Directive "concerning urban wastewater treatment", (91/271/EEC) lays down minimum standards for the provision of sewage collection systems and sewage treatment. Extracts from the Directive are contained in Appendix ***. 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 (see Section ***). 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.

Groundwater quality within the catchment is generally reflected by river water quality observed 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.

Evidence of suitability of groundwater for potable use is provided by a baseline survey of private water supplies located throughout rural areas of Devon and Cornwall which was undertaken by the NRA in 1992/3. While only forty eight samples were obtained from the freshwater Tamar catchment, subject to differences in catchment land use, the overall results are likely to be applicable to most catchments in Devon and Cornwall. The data shows groundwaters generally comply with drinking water standards. Notable exceptions were for bacteriological contamination, which in general can be attributed to poor well maintenance, and for nitrate where approximately 10% of sources exceeded the EC Drinking Water Directive (ref) standard. The most important nitrate inputs are likely to arise from agricultural activities, although locally inputs from septic tank drainage may be significant.

ANNEX 1A REDUCTION PROGRAMME

At the second and third North Sea Conferences, the UK Government made a commitment to reduce the loadings (concentration x flow) of certain substances ('Annex 1A' substances) (Appendix D, Table ***) entering tidal waters from rivers and direct discharges. 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 run-off 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. Organotin, in the form of triphenyltin is used as a fungicide and acaricide. (It is possible that the organotin was also present in the form of dibutyltin which is used as a plasticiser and is often found in sewage).

Issue 4: Following national compilation of data, if the River Tamar appears on the national priority list, investigations may be required to determine the source of these Annex 1A organic substances and reductions in loads may have to be sought.

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. In addition algal blooms, originating from the Lower Tamar Lake, have been observed floating down the River Tamar. 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 Tamar Lakes and Catchment.

Issue 5: Possible eutrophication of the Tamar Lakes and Tamar Catchment.

Suspended Solids

Scale of the Problem

Data from PARCOM monitoring suggests the problem is worsening, ie loads are increasing, see Tamar water quality plan produced for CMP. However a 1992 NRA report by R. Smith concludes:

- 1) Suspended solid concentrations exceed standards (now not applicable).
- 2) Source thought to be catchment wide.
- 3) Data shows that SS concentrations have not actually increased over period 1974-1991, and that this is merely an artifact of sampling.
- 4) High recorded levels are not necessarily indicative of a worsening problem, more a factor of the nature of monitoring. (Daily monitoring would be required to plot any real trends)

Nature of the Problem/Source

Three sources of SS have been identified:

- a) Channel erosion.
- b) Surface water run-off.
- c) Land drains.

An NRA report by Bruce Newport (1994) on the Deer concludes:

- a) River flow and SS are related.
- b) The headwaters SS concentrations are lower than in the main tributary/river channel.
- c) Agricultural land generally stabilised by vegetation allowing good quality surface water run-off.
- d) Minimal impact of run-off in spate events.
- e) The slope of watercourses are directly linked to suspended solid concentrations.
- f) Major source of suspended solids in spate events is the main tributary/river channel.

Tim Harrod produced a report for the NRA in the late 80's on the effect of land use on water quality in the Torridge and Tamar. He has also carried out work on the Thrushel, Deer, Wolf and North Lew as part of the Roadford study (I have not been able to obtain a copy of this report).

The Tamar system is intrinsically susceptible to erosion and geomorphologically very active. Whilst it would seem to be clearly indicated that the bulk of suspended solid material is coming from in channel erosion related to spate events, surface water run off or land drainage may be the sources of a higher proportion of colloidal sediments. These colloidal sediments could be particularly important in some of the gravel concretion and fisheries related problems.

It may be thought that for such sediments the suspension time will be high and impact in the upper reaches therefore likely to be low. However, the effects of abstraction on a regulated system may override this natural effect. Work on the River Wolf as part of the Roadford project (ref), certainly indicates an increase in the composition of these finer sediments within the gravels and associated problems. Whether this can be extrapolated for use in the main Tamar is a question for debate.

One method of finally identifying the sources of the differing compositions of material, would be caesium research.

Note: Land drainage may reduce the hydrographic peak and therefore help in channel erosion.

Methods of Control

- a) Channel erosion: Bank stabilisation could be undertaken to reduce erosion. Methods could include 'hard' or 'soft' engineering options..
Hard would be unlikely to be a generally acceptable option, in terms of cost, conservation and landscape grounds.
Soft - there have been many proposals about the planting of a buffer zone with trees and shrubs alongside eroding banks to cut down on erosion. MAFF were proposing a scheme of grants to induce farmers to plant buffer zones within the Tamar. This failed largely because the funding offered was inadequate to compete with the land use margins farmers could expect to achieve through farming the land. The effectiveness of this method has also yet to be proved. However, the NRA Deer project has undertaken significant amounts of planting alongside watercourses. Obviously this project is in the early stages but it may be desirable to carry out close monitoring of erosion along this planted length measured against a controlled section to gauge effectiveness and relate to cost benefit (is this possible?).
- b) Surface water run-off: Buffer zones are again being proposed to slow down surface water run-off and cause SS to drop out of suspension prior to entering into the main channels. Certainly natural wetlands fulfil this function. However, I have not been able to establish any documentation on the suitable width and composition of buffer zone required to be effective for this function.
- c) Land drains: Encourage non-maintenance of land drains and/or actively promote breaking them up. Uptake of this option, as with the MAFF scheme, would depend on adequate compensation being provided.

Impacts (that I am aware of):

NRA invertebrate sampling - results show high quality and there are no monitored impacts.

General ecology - high quality and no monitored impacts.

Impact on fish - the impacts of fine sediments on embryo survival rate is well documented, ie, recent NRA R&D 152 on the Torridge. Unaware of any impact of sediments on young or adult fish.

Physical impact: the natural erosion of river banks suits certain species, ie, sand martins, however general loss of riparian vegetation can reduce species diversity.

Cost implication on SWWSL abstraction at Gunnislake.

Gravel concretion. The exact nature of the causes of concretion are not known. It may be a function of sedimentation x flow x metals x organics (x other ?) in any combination.

Initial analysis of concreted material shows high levels of iron and manganese present. Naturally these materials, through changing pH and reduced oxygen process, form a hard residue known locally as 'black ram'. Concretion could be an extension of this, but what are the drivers? Fresh water sponge were also found in concreted material. It is likely

that the sponge will only start to colonise once the stabilization process has started, however it may then increase the rate at which concretion occurs.

More detailed analysis of concreted material can be done, looking at composition and geology (ie source). This may throw more light on the nature of the cause of the problem. Plymouth University are willing to quote for this work. It is also likely that Tim Harrod at the soil survey would also quote for the work. Both have now received a sample of the concreted material and the initial analysis was done by Plymouth at a very rapid level for free on the request of Rob Torr.

It would seem essential that prior to any further work being done a proper scoping exercise of relevant research is undertaken. To date I am aware of relevant work that has been done as part of the Roadford study on the Tamar system, and work that has been done on the Torridge. Both of which reports are held in the region. Furthermore, I believe nationally work is being undertaken though how relevant this is to the South West remains to be seen.

Detailed monitoring of current projects on the Tamar, notably those associated with the Deer, would seem also to be fundamental in assessing how effective we can be in preventing the problem occurring and what the benefits of those actions could be. These benefits might not be purely to the physical composition of the substrate. Wardens perceive that loss of riparian habitat is impacting on the fishery both in the reducing lies for adult fish and habitat for young fish. The surveys may highlight benefits from such planting.

If it is decided to advance this subject it needs to be clearly defined as to which function or functions should be the lead.

Issue 6: High levels of suspended solids in the Tamar Catchment.

Acidification

The top stretch of the River Lyd (A386 Roadbridge at Lydford) is affected by acidic run-off from Dartmoor (see Water Quality Objectives section). In the headwaters of the Rivers Kensey and Ottery there have been fish kills in the first spate after a period of low flows see 4.2.1.

As both are identified as being natural in origin there is not considered to be an issue. The headwaters of the River Lyd are acidic in nature (see 1.6.3). This area has been identified as a critical load area for forestry (see 4.4.1), ie where the NRA must be assured that any new forestry plantings will not reduce the pH.

Issue 7: Acidic run-off

5.2 WATER QUANTITY

5.2 WATER QUANTITY TARGETS AND CURRENT STATE

Future demand for water

As part of the work to develop a Regional Water Resources Development Strategy, the NRA has produced forecasts of future demand for both public and private water supply.

Public water supply

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.

In the Regional Water Resources Development Strategy, the NRA has produced forecasts for the area served by SWWSL's Roadford Strategic Supply Zone, which includes most of the Tamar catchment.

Two alternative scenarios are presented in the form of a "high" and a "low" forecast. The former assumes high growth in all consumption, no improvements to reduce losses or any increase in domestic metering to reduce water use. The latter 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 number of properties metered.

The forecasts for 2021 are:

SWWSL Roadford Supply Zone	High	347 MI/d
	Low	291 MI/d

Resource/Demand Balance

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

Resource Development Options

Clearly, 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 for 20 years or more.

Alternatively, if demand does rise as under the "high" scenario, major sources would be needed. In line with NRA Water Resources Policy, the options would be in the following order of preference, demand management, resource management and resource development. For background information on these options the reader is referred to the NRA's Regional Water Resources Development Strategy (..ref) where these issues are discussed in detail.

Specific developments which would affect the Tamar catchment and how its water is used are:

Roadford Operational Management Strategy (OMS).

The NRA is currently embarking upon a project (involving the construction a computer simulation model of the system) which will devise a detailed Operational Management Strategy for the Roadford Strategic Supply System. The aim is to develop an operation

system which optimises the use of the water resource, whilst taking into account environmental considerations.

The co-operation of the undertaker, SWWSL will be essential to the successful implementation and operation of a Roadford OMS.

The conjunctive use of the sources associated with Roadford will need to be clarified by the OMS and this might result in a reduction in the reliable source output, in order to meet environmental requirements.

Roadford Pumped Storage.

This would involve pumping water from low down in a catchment back up to Roadford at times of high flows, ie winter, and is an option for meeting the future potential shortfalls in resources which would occur under the "high" scenario.

It would be attractive to the NRA because best use would be made of an existing reservoir and it would defer the requirement 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/d reliable source output could be obtained. However, this is only an estimate and needs to be investigated further.

Additional links between Roadford, Colliford and Wimbleball Supply Zones.

These would help make the best use of existing SWWSL sources. However, large scale imports from the Colliford Zone under a "high" scenario are unlikely to happen because this Zone would have insufficient resources to meet its own demands in such a situation. Imports of up to 5 Ml/d from the Wimbleball Zone may be possible but this has yet to be investigated.

At this stage it is impossible to make a complete assessment of the impacts upon the Tamar catchment, which is one of several affected by the Roadford scheme, through any developments/changes to its operation.

However, the work that is currently being carried out on the Roadford system will help to clarify current and likely future operation, in particular the demands that will inevitably be placed upon the key sources of Roadford Reservoir and the Tamar at Gunnislake.

Issue 8: Operation and supply of water in the Roadford supply zone.

Private water supply

Predictions of future growth in demand for private water supply are even 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 makes the following predictions for future growth in private demand:

	% Growth Rate/Year
Agriculture (general)	0%
Spray Irrigation	1.7% to 2001, 1.0% 2001 to 2021
Fish Farming	0%
Industry/Commerce	0.75%
Private Water Undertakings	0%
Hydropower	0%

Applying these rates to the nett resource commitment, it is predicted that private demand

in the Tamar catchment will increase by some 417 Ml/year by 2021. Growth in private supplies tends to be made up of numerous small abstractions (see 4.11) which are geographically dispersed, in contrast to the more concentrated point source for public water supply. The implication is that impacts, if any, is likely to be small and localised. The growth rate for industrial use may be excessive given that in reality there might be no increase in abstraction for this purpose.

Low Flow Sites

In 1990 the NRA South West Region commissioned Sir William Halcrow and Partners to produce a report identifying the problems caused by artificially low river flows within the region. This report 'NRA South West Region - Low Flows Study' (..ref) identified 109 low flow sites where low flows could adversely affect the river in terms of amenity, fisheries or ecology. Problem sites were ranked as 'serious, major, medium, small and minor' according to their perceived severity of low flow effects.

Within the catchment there were four identified sites where there are perceived low flow problems:

- Lower Tamar Lake (major).

The NRA is concerned about reduced flows in the River Tamar below Lower Tamar Lake having an environmental impact and is currently monitoring juvenile salmonid production. (see Section 4.2.2 Fisheries).

The Tamar Lakes are an important conservation and recreation resource, used widely for angling, canoeing, sailing, birdwatching, picnicking and walking. Lower Tamar Lake is a nature reserve. The Tamar Lakes provide a wide expanse of open water with valuable fringing habitats. The main interest is in wintering wildfowl but other notable species frequently use the lakes. Otters are thought to have bred on the upper lake in the past (monitoring is not regular enough to know more details), and it is likely that they breed in the lower lake reed beds.

As reed beds themselves are fairly uncommon in freshwater systems in Devon and Cornwall, those at the lakes, although relatively small in area, are important and water level management of the lower lake in particular should reflect this.

SWWSL have recently advised CBWPS that the company cannot afford £0.25 million needed to repair the weir and propose to reduce the size of the lake as a solution to the instability in the dam. This would reduce the area of water by two-thirds of the area of water, thereby impacting on the recreational uses and the supply of water to the Bude Aqueduct.

We have serious concerns over SWW proposals to lower water levels in this lake, without carrying out a full environmental impact assessment.

Currently, SWWSL are looking at reducing the size of the Lower Tamar Lake as a solution due to instability in the dam. Alan Weston to check with SWWSL on public position re. above - ACTION AEW and or we need to include details of the EA- David Sherif/Peter Nicholson

Issue 9: Secure long-term solution for Lower Tamar Lake.

- Trecarrell Mill (minor). A LoE for hydropower has the potential to have an impact on the River Inny. In determining the license the NRA was involved in discussion with the owner who has agreed to certain voluntary conditions to diminish potential environmental impacts. *Sheila Turner checking file.*

- Woodley Stream (small). A fish farm which has the potential to dry up a stretch of the stream during low flows. There is a residual flow condition *is this not enough and should it be reviewed??* The property is currently not being run as a commercial enterprise but licenses maintained as the residence was built as an

agricultural dwelling...does this present us opportunities. ~~NB owners would not wish this fact widely known~~

Gunnislake abstraction (small). A residual flow condition exists to protect environmentally acceptable flows. This will be included within the review for the 2002.

The licence originally granted by the Secretary Of State for abstraction at Gunnislake set a prescribed flow at 246 Ml/d. However, in an undertaking given to the Tamar & Tributaries Fishing Association at the Public Enquiry in 1978, the prescribed flow was set at a higher level of 477 Ml/d for a period of 10 years from 1992. South West Water undertook to apply for an abstraction licence variation prior to reverting to the original licensed prescribed flow.

It is the 2002 review which will formalise any future investigations on the operation and impact of the Roadford scheme. The NRA is currently engaged in the Roadford Operational and Environmental Study, a project to prepare the necessary information in advance of any licence variation application by SWWSL.

See Issue 8

General impacts of water levels on wildlife

Knowledge of the catchment wildlife is not sufficient 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 10: Lack of knowledge of wildlife flow requirements.

Water levels and recreation

Canoeing takes place on the River Tamar. The season is not limited by flow requirements.

The only other identified use is fishing. ~~Is this impacted by flows? can anything be done?~~

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.
- Cornish side of the Tamar Valley from Tamerton to Stoke Climsland as an AGLV.

The proposed production of Biomass energy in Torridge district has implications for landscape and for wildlife. Increasing woodland cover is generally desirable but there are concerns about such plans impacting on the water environment through possible loss of valuable habitat particularly wet grassland unless sited carefully.

Issue 11: Need for full consultation over proposed biomass planting sites.

River structure

River channel

Targets

- Maintain or re-establish natural channel morphology within watercourses.
- Maintain appropriate levels of in stream vegetation to provide adequate cover for fish and habitats for other wildlife associated with the river.
- Maintain and improve salmonid spawning areas.
- Artificial barriers must not obstruct the passage of migratory fish. Provision must be made for the free passage of migratory fish in any new structure and existing passes must be maintained. Any new structures in or adjacent to the water course should be sympathetic to the surrounding landscape.
- Natural or artificial barriers should not lead to excessive exploitation of fish.

Current State

Riparian Zone

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. On the Cornish side of the catchment semi-natural habitats make up approximately 15.04% of total land area. Sub groupings are given in the table below:

CATEGORY	Area (Hectares)	% of Total Area
Open Water	119.45	0.21
Wetland	457.10	0.81
Possibly unimproved grassland	1555.47	2.77
Unimproved Grassland	2094.13	3.73
Broadleaved Woodland	2827.54	5.03
Heathland	153.16	0.27
Scrub	277.04	0.49
Disturbed Ground Community	0.00	0.00
Conifers	811.20	1.44
Bracken	160.67	0.29
Saltmarsh	0.00	0.00
Total area of Semi-Natural Habitat	8455.75	15.04
Total Area of Upper Tamar (Cornwall)	56212.41	100.00

A much more detailed breakdown is possible, which could be of particular benefit highlighting areas undergoing change from one habitat type to another, ie. scrub and wetland mix, and which offer an opportunity for recreation.

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 conifer plantations, which are generally recognised as having reduced conservation value. Forest Enterprise are effecting phased change on their holdings to plantings alongside watercourses with particular consideration for conservation, recreation and landscape interests. This is in line with the Forest and Water Guidelines (ref), (see Section 4.4).

Issue 12: The restoration of native deciduous woodland and associated vegetation.

Little work has been done on assessing the loss of such (riparian) habitat, though the importance to the fishery and general wildlife is widely recognised. The use of Aerial photography and habitat mapping (once 2 sets of data exist) in conjunction with old phase 1 habitat survey, River Habitat and River Corridor Surveys where they exist, would enable an assessment to take place. From this may stem various actions to conserve or replace such vegetation. There is a need therefore for greater knowledge of the vegetation and morphology along the riparian zone (as well as river channel and flood plain).

Surveys of broad categories of habitat within the catchment have been undertaken through the interpretation of aerial photographs. This could be compared against previous data to monitor rates of habitat change, and the importance of sites in a Regional context. For the purposes of site specific river work 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 or projects, or which we own. Resources do not allow for extensive RCS throughout the catchment, or to adequately manipulate the data once gathered.

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 could be the intermediate methodology required to link the habitat data and RCS.

Issue 13: Lack of information on the status of riparian habitats throughout the catchment.

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.

The removal of bankside trees is leading to destabilisation of river banks. The banks dry and shrink in summer and are washed into the river during a spate. The removal of bankside trees also removes lies for fish and other water life. Bank erosion exacerbates the suspended solids problems in the Tamar.

Issue 14: Protection and enhancement of riparian strip

Flood Plain

Culm Grasslands

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.

Of 605 hectares of Culm Grassland within the Devon parts of the Tamar catchment, 245.54 ha. are protected under various conservation schemes.

All sites within Devon above 0.5 ha are identified as County Wildlife Sites.

Cornwall ~~???? (from Conservation section. to come)~~

Apart from the important communities and species they support an important natural function of culm grassland is as wetland in the headwaters and upper catchment, with all knock on benefits to the catchment of delayed water release to water courses, natural buffering etc.

Devon Wildlife Trust have concerns over the loss of flood plain wetlands and lack of strategic approach to flood plain wetland restoration. DWT would support such an approach and the implementation of an action plan. A possible area target would be from the Kensey/Tamar confluence downstream to Greystone Bridge. Wildlife benefits for feeding birds, as well as the overall benefit of a return to more natural river and flood

plain processes.

Issue 15: Develop the protection of existing wetlands, especially Culm grassland, and actively seek opportunities to recreate wetland habitats.

Wider Catchment

Agriculture is a continuous threat to the water environment, on a day to day basis where there is inadequate infrastructure or management, or from one off pollution incidents. Section 5.1 indicates there are agricultural units which are impacting the water environment.

With a high number of animal units in the catchment the threat of slurry related incidents is high and continued vigilance is required.

Agricultural land use has intensified in the upper catchment. A higher density of cattle, mostly dairy, lead to its own problems; bank erosion, "poaching" of soil and associated vegetation and compaction of land, increasing surface water runoff. Hedgerow loss and increased field sizes have meant habitat loss, increased velocity of runoff to channels and a lack of buffering leading to increased suspended solids.

See Issues .

Replacement of semi-natural deciduous forest with large blocks of single stand conifers is seen to have reduced the conservation and landscape value within the catchment. 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. 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. The NRA looks to input into forestry plans when the Forestry Authority and planning Authorities are granting planting licences.

Issue 16: The re-establishment of "mixed stand" forestry.

As discussed in Section 4.4 only a small part of the catchment falls within an identified Critical Load area. The headwaters of the catchment outside this area are acidic and the NRA would have concerns about any new large plantings in these areas exacerbating the problem. The NRA will continue to liaise with the Forestry Authority to prevent any such impact.

Are there any other areas not identified as critical load which we should be concerned about??

Species Protection

The Salmonid fishery

Optimizing the size of the natural Salmonid fishery to fulfil its environmental capacity. It is not presently possible to establish an exact target for the maximum carrying capacity for salmonids, and thus a cut off point for NRA efforts. However the NRA is currently involved in implementing a classification scheme following a research and development project. This will enable the NRA to set definite stocking 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 final plan and will be used with the Gunnislake fish counter to set targets and monitor achievement.

Despite not having the classification scheme up and running the natural fishery of the

Tamar catchment is considered as being of very high quality, as shown in various surveys (section 4.2.1 and Appendix **). 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 Derril Water, Small Brook and Tala Water.

Within these areas major constraints are thought to be;

- * poor water quality on some rivers due to: persistent pollutant inputs, ie agricultural land run off or mining; one off pollution incidents; or high suspended solids. These issues have been looked at fully in section 5.1.
- * lack of spawning gravels. On the tamar there are areas where existing gravel beds have become cemented together (known as concreted gravels) and fish are unable to spawn. The potential causes of this concretion are dealt with more fully in section 5.1 but may be due to a combination of factors including suspended solids, organic inputs, metals, plant growth, river flows and changes in land use.

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.

- * 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 localised change in the flow regime resulting in impoundment of water and possible siltation of gravels.

Overhanging trees and smaller blockages are a natural part of the river system providing substrate, food and shelter for in-stream ecology and scouring out pools and possibly rejuvenating gravels. The importance of these effects is recognised by NRA, who follow 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 recognised 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 17: Removal of trash dams and trimming of overhanging trees preventing passage of fish or impacting spawning gravels.

- * 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 13

- * 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. The continuation of the ongoing Upper Tamar ALF studies (see Section 4.2.2); and/or,

the results of the current environmental assessment by SWWSL (see Section 5.2) will give indication of remedial action needed and where effort is best spent in rehabilitation.

See Issue 8

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 were identified upstream of Launceston. Gravels 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 minimise the downstream movement of spawning gravels to form enhanced spawning beds.
- Artificial spawning beds have been constructed using imported gravels. 8 have been constructed within the Upper Tamar area.
- Installation of crows 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 18: Continued monitoring of the natural fishery with emphasis on the recently improved areas.

Particular Stock Components

Multi Sea Winter Salmon : Since the early 1970's 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. This change may be cyclical in the long term, climate dependant or may be related to high seas fisheries strongly selecting multi-sea winter fish. The outbreak of Ulcerative Dermal Necrosis (UDN) in the 1970's dramatically affected spring salmon. There appears to be a reduction in the incidence of three sea winter salmon and previous spawners caught within the rod fishery. 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. The NRA South Western will assist in promoting a nationl investigation into the decline of 2 Sea Winter and 3 Sea Winter salmon and will consider possible byelaws to increase escape.

Issue 19: Decline in catch of multi sea winter salmon

Spring Salmon : 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 take action. Relating rod catch (and net) returns to fish counter results it is seen that therefore the NRA will seek to encourage measures to reduce impact.

Issue 20: Decline in returning Spring Salmon

Sea Trout : Since 1989 catches of sea trout have declined 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 21 : 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 be aware of the need for a NRA rod licence.

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

Issue 22: 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 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 cooperate with the licensing authority to progress further research into this issue and will continue to work positively with owners and anglers to establish the full facts in each situation.

Introduced and escaped fish

Throughout the catchment are numerous still-water lakes 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 4.2.2). The NRA has concerns that these may compete with and introduce disease to the native fishery.

NRA Southwestern will update their data base on the distribution of non-native fish species within still-waters of the Tamar catchment and carry out regular inspections of these still-water fisheries in order to minimise the risk of escapes. *Or should this text be deleted and just used as issue options??*

Issue 23: Introduction of non-native fish species

Loss of natural Channel

There was a loss of natural channel on the River Wolf (including salmonid spawning areas) when Roadford Lake was constructed. Mitigation work in the form of a breeding and release programme is ongoing. Siltation of gravels due to regulated flows from Roadford reservoir may have caused a decline in the Wolf trout population. Salmon redds found in the reaches below Roadford Reservoir seem unproductive, possibly due to siltation.

The continuation of the Roadford Operational and Environmental Study (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 24: 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. In 1993 salmon fry were recorded above Ashmill weir at two sites for the first time. 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 pass.

Improvements to a pipe bridge over the River Carey which may obstruct the free passage of fish should be investigated.

Issue 25: Pipe Bridge on River Carey perceived as obstacle to fish

Acid Waters

Whilst the cause of post drought acidification in the Rivers Kensey and Ottery have been proven to be natural (see 4.2), the importance in fisheries terms needs to be recognised and may warrant mitigation measures to be taken. Such measures could include artificially maintaining pH through liming in the first rains after a drought.

See Issue 7

Roadford Reservoir

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

The NRA South Western will continue the Roadford Operational and Environmental Study until sufficient flow related data is gathered.

See Issue 8

The River Claw, upper Henford Water, Luckett Stream and the Ogbeare Stream

Poor salmonid juvenile densities have been recorded on these streams. Luckett Stream has elevated copper levels 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 ~~will~~ be investigated with a view to implementing alleviation measures.

Issue 26: Poor salmonid juvenile densities on the River Claw, upper Henford Water, Luckett Stream and the Ogbeare Stream.

Otters

The whole of the Tamar catchment supports an otter population of international importance, from which there has been a notable expansion and increase in distribution in the 15 years since the national surveys began. A precautionary approach should be taken 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'.

Related to this, 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 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 need to continue.

Issue 27: Continued monitoring of otters to ensure the species and its habitats are protected

Freshwater Invertebrates

The NRA carries out an invertebrate monitoring programme throughout the Tamar Catchment. The results of this work are used primarily for water quality, 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 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 1? due from biologists (via Thames). More detailed site descriptions are given in Appendix E.

As can be seen on the map the Tamar is .

Other Species

The presence of locally and nationally important species within the catchment are 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.

Other 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 carry 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

Invasive Species

Japanese Knotweed and Himalayan Balsam are present throughout the catchment, though their full extent is not known. Giant Hogweed is growing at Endsleigh. Impacts on native species can be locally significant and work needs to be done to monitor both spread and impact.

Issue 28: Assess the extent and impact of invasive species

Archaeology

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 Waterlevel 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 29: 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 its otters and national importance for its mosses and lichens. Any increase in human activity may disturb the wildlife. There is a nationally recognised 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 minimise such conflicts.

Issue 30: The development of recreational paths

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 5

Canoeing

Canoeing takes place on the River Tamar under an access agreement with the BCU. 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 riparian interests. There is a need to improve safety at some canoe access points on the Tamar. Following negotiations with the landowner, NRA and BCU work has started on steps at Horsebridge.

Issue 31: To help promote the responsible use of the River Tamar by canoeists

5.4 FLOOD DEFENCE

Targets for flood defence may be prescribed (eg. the time allowed to determine a flood defence consent), indicative (eg. relating to the level of flood protection appropriate to a particular land use), or business (eg. 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/ 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.*
- * *Issues 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 will be introduced into the Region during 1996. Data collection is programmed for completion by March 1996.*

~~FDMS now on hold - do we rewrite/delete?~~

Regulation

We advise planning authorities on flood defence matters. We also issue consents and bylaw 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.(..ref)

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.

We need to identify flood risk for Planning Authorities. This should take account of the timetable for preparing district wide Local Plan(s).

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.

Issue 32: Identification of flood risk to Planning Authorities

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

Development plans for building in the flood plains at Launceston, Holsworthy and Tinchay.

The proposed growth of Launceston's industrial estates on land that is currently farmland or open space will increase the amount of surface runoff.

The NRA is concerned at the impact development could have on the headwaters of the Lowley Brook to the south of Launceston. The NRA is concerned about inappropriate development, particularly in the flood plains, that will affect standards of flood defence and damage environmental interest.

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 flood plain.

Issue 33: Increased surface water runoff to Lowley Brook

Issue 34: New development in floodplains

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.

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.

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 *** below)

The methodology splits the river into reaches and defines typical land use on either side of the river (see Table ** below). 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 while scores above 1.0 HEs/km/year indicate that maintenance might need increasing.

The system originally only looked at flood damage. However, it is recognised 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.

The map opposite shows the land use banding for the Tamar catchment.

Table **: 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>

Table **: Land Use Factors

Land Use Factor	Unit	HE units
House	Total number	1.0
Garden/allotments		0.04
NRP- Distribution	Total area (m ²)	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

We have a duty to conserve wildlife when we carry out flood defence work.

Target To manage water levels properly for farming, flood defence and wildlife particularly in special sites.

There are 2 SSSI within the catchment where English Nature (EN) have identified a Water Level Management Plan, in accordance with Ministry of Agriculture Fisheries & Food (MAFF) guidelines.

names of sites near Holsworthy

Water Level Management Plans are required for those Sites of Special Scientific Interest where we control water levels, by 1998.

The NRA will work with MAFF, EN and others to develop ... (specific sites should be referred to, with a programme if agreed.)

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 following indicative standards (return period in years) to design schemes:

Current Land Use	Sea	River
High density urban, containing significant residential and non-residential property.	200	100
Medium density urban.	150	75
Low density or rural communities. Highly productive agricultural land.	50	25
Generally arable farming with isolated properties.	20	10
Low productivity land with few properties at risk.	5	1

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.

We maintain a register of flood problems and we are developing a Long Term Plan of Needs.

Require information on:

Flood problems for investigation have been identified at ... locations within the catchment.

A programme to review flood problems is being undertaken as part of the Development & Flood Risk Surveys. *Be specific where the timetable is known.)*

Issues?

Do we include information on:

The introduction of the Flood Defence Management Framework identifies the relative priority of schemes to alleviate flooding problems.

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.

We are considering flood alleviation / sea defence schemes at...

Detail the timetable and stage reached for each scheme.

Issues?

Emergency Response

Absolute flood protection is not possible. Because of this we need to warn people when there is a danger of flooding. We have a strategy Emergency Response Levels of Service (ERLOS) which details how these procedures operate and which we use to improve our emergency response.

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. Within the catchment the flood warning system has been operated within the target of 2 hours. It has been identified however that the warning system is not complete, the omissions being for Launceston and Lifton. To address this shortfall the NRA plans to build new sites at Egloskerry on the River Kensey and Sydenham on the River Lyd.

Awaiting information

Target Prepare and keep up to date a plan for responding to flooding and damaged flood defence structures.

Describe the current situation, with reference to the particular catchment. Describe response Level A and Level B locations and activities.

Issues?? *These could be either issues relating to identifying appropriate standards, or issues in meeting those standards.*

No	Issue	Options	Advantages	Disadvantages	Responsibility	
					Lead	Others
1	Marginal non-compliance with WQO due to agricultural activity. Farming activities cause: 1 Marginal non-compliance with WQO in the River Tamar 2 Marginal non-compliance with WQO for Greenlanes Bridge in the River Lyd 3 Marginal non-compliance with the WQO for Stowford Bridge in the River Inny 4 Marginal non-compliance with the WQO for Truscott Bridge in the River Kensey 5 Marginal non-compliance with the WQO for Bolesbridge Water	All issues * Investigations to identify sources * Promote COGAP and farm waste management plans (including farmers self assessment)	All issues * Achieve WQO compliance and environmental improvements	All issues * Cost	NRA	MAFF, NFU,CLA

No	Issue	Options	Advantages	Disadvantages	Responsibility	
2	The effect of local geology/abandoned mines on water quality.					
	1 Exceedence of the 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
	2 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	
	3 Inputs of metals from abandoned mines and waste tip sites.	<ul style="list-style-type: none"> * Following national compilation of Annex 1A data, if the River Tamar at Gunnislake appears on the national priority list, reductions in metal loads may have to be sought if point sources can be identified. * Non disturbance of Devon Great Consoles spoil tips. 	<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 	NRA	
	4 "Set aside" of copper data for the River Tamar at Gunnislake.	<p>Issues 2.4 & 2.5</p> <ul style="list-style-type: none"> * Continue monitoring to confirm if caused by natural geology/historic mining * NRA to seek a derogation for copper /zinc 	<p>Issues 2.4 & 2.5</p> <ul style="list-style-type: none"> * Compliance with directives * Compliance with directive 	<p>Issues 2.4 & 2.5</p> <ul style="list-style-type: none"> * None known * None known 	NRA/LPA/ Landowners	
	5 Exceedence of the EC Freshwater Fish Directive imperative standard for total zinc at Two Bridges.				NRA	

No	Issue	Options	Advantages	Disadvantages	Responsibility	
3	Increase in gamma HCH downstream of St Leonards STW and Holsworthy (Derriton New) STW from 1991 to 1992.	<ul style="list-style-type: none"> * Review consents * Continue monitoring * Identify source 	All options * Improved water environment	<ul style="list-style-type: none"> * None * Cost * Cost 	NRA NRA	SWWSL
4	High loads of organic Annex 1A substances in the River Tamar at Gunnislake	<ul style="list-style-type: none"> * Following national compilation of data, if the River Tamar appears on the national priority list, 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	
5	Possible eutrophication of the Tamar Lakes and Tamar Catchment.	<ul style="list-style-type: none"> * Continue Monitoring * Carry out investigations * When complete, carry out recommendations 	All Options * Improved water environment	All Options * Cost	NRA NRA NRA	SWWSL land owners
6	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: * Improved water environment	All Options * Cost	NRA NRA	MAFF MAFF / Land owners

No	Issue	Options	Advantages	Disadvantages	Responsibility	
7	Acidic run-off 1 "Set aside" of pH data at Lydford 2 Acidic run-off leading to fish kills on the River Kensey	<ul style="list-style-type: none"> * Continue monitoring to confirm if caused by natural geology * NRA to seek a derogation for pH * Mitigation work post drought to artificially maintain pH 	<ul style="list-style-type: none"> * Compliance with WQO * Diminished fish losses 	<ul style="list-style-type: none"> * None known * None known * Cost 	NRA NRA NRA	
8	Operation and supply of water in the Roadford supply zone.	<ul style="list-style-type: none"> * Modelling of supply zone and potential additional resources. * Environmental assesment of of water environment to aid determination of revised Gunnislake abstraction licence in 2002. To include fisheries/conservation surveys. 	<ul style="list-style-type: none"> * Efficient use of waer resources. * Improved water environment/fishery 	<ul style="list-style-type: none"> * Resources * Resources 	NRA NRA	SWWSL SWWSL/DWT/EN/CWT 10
9	Secure long-term solution for Lower Tamar Lake	<ul style="list-style-type: none"> * Environmental Assesment * Low flow study 	Both options <ul style="list-style-type: none"> * Maintenance of water qualityand habitats and the protection of wildlife and other users. 	<ul style="list-style-type: none"> * Cost 	NRA	SWWSL DWT/ CWT/ CBWPS/ Canal society
10	Lack of knowledge of wildlife flow requirements.	<ul style="list-style-type: none"> * Implement R&D when results become available. * Survey and monitor wildlife. 	All Options: <ul style="list-style-type: none"> * A sound basis for decisions that will improve the health of the catchment. * Efficient use of resources 	<ul style="list-style-type: none"> * Cost and timescale. * Cost of surveys/ monitoring. 	NRA NRA	Conservation groups, ie EN/DWT/CWT / RSPB

No	Issue	Options	Advantages	Disadvantages	Responsibility	
11	Need for full consultation over proposed biomass planting sites.	<ul style="list-style-type: none"> * Liaison with power companies and planning authorities to ensure sites do not impact on the water environment. 	<ul style="list-style-type: none"> * No loss of wetland and other valuable habitat. 	<ul style="list-style-type: none"> * Economic implications 	NRA	LPAs/Land owners/ Power companies
12	The restoration of native deciduous woodland and associated vegetation	<ul style="list-style-type: none"> * Planting grants to encourage deciduous planting * Promotion of 'Forest and Water Guidelines' * Guidance when felling and planting licences applied for 	<ul style="list-style-type: none"> * Financial help to restore habitats * Established practices * Improve habitats for wildlife 	<ul style="list-style-type: none"> * None Known * Cost * None known 	Forest Authority	Land owners, NRA, CoCo, Forest Enterprise
13	Lack of information on the status of riparian habitats throughout the catchment	<ul style="list-style-type: none"> * Revue historic data * Develop habitat mapping/GIS * Implement R&D to set targets and monitor * Implement River Habitat Survey methodology once agreed * Liaison with relevant outside bodies, EN, CWT etc 	All options: <ul style="list-style-type: none"> * The ability to improve on best practise * Better allocation of resources 	All options <ul style="list-style-type: none"> * Cost 	NRA NRA NRA	All: EN, CoCo, CWT, DWT and other conservation bodies
14	Protection and enhancement of riparian strip.	<ul style="list-style-type: none"> * NRA works carried out to Best Practise * Encourage landowners to protect riparian strip * Restoration/ replanting 	All Options <ul style="list-style-type: none"> * Improved water environment for wildlife * Reduce bank erosion * improve quality of surface water run off 	All options <ul style="list-style-type: none"> * Cost 	NRA NRA	land owners, conservation bodies

No	Issue	Options	Advantages	Disadvantages	Responsibility	
15	Develop the protection of existing wetlands, especially Culm grassland, and actively seek opportunities to recreate wetland habitats.	<ul style="list-style-type: none"> * Use of schemes such as Countryside Stewardship Schemes to encourage landowners to preserve habitats. * 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. * Uptake likely to be better if preservation undertaken voluntarily. 	<ul style="list-style-type: none"> * Need to inform landowners of grants. * Requires monitoring. * Resources 	NRA	CoCo/ EN/Land owners
					NRA	Planning Authority
					NRA	EN/ FWAG/ NFU CoCo/ CWT/ DWT
16	The re-establishment of "mixed stand" forestry.	<ul style="list-style-type: none"> * Promotion of mixed species planting. * Promotion of mixed age blocks. 	Both Options: <ul style="list-style-type: none"> * Improved conservation and landscape value. 	Both Options: <ul style="list-style-type: none"> * Potential economic loss. 	Forest Authority	LPAs/ CoCo/ NRA/ Landowners
17	Removal of 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 water environment. 	<ul style="list-style-type: none"> * Cost * Potential environmental impact 	NRA	Fishing clubs
18	Continued monitoring of the natural fishery with emphasis on the recently improved areas.	<ul style="list-style-type: none"> * Monitoring fish populations by use of fish surveys/ counters/ catch returns. 	<ul style="list-style-type: none"> * Establish success of work and benefit of expenditure. 	<ul style="list-style-type: none"> * Resources 	NRA	

No	Issue	Options	Advantages	Disadvantages	Responsibility	
19	Decline in catch of multi sea winter salmon.	<ul style="list-style-type: none"> * Promote a National NRA investigation into the problems * Continue monitoring: fish Scale analysis of 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
20	Decline in returning spring salmon	<ul style="list-style-type: none"> * Promote study into causes * Promote measures to reduce numbers of fish taken by rod 	Both options <ul style="list-style-type: none"> * Improve fishery 	<ul style="list-style-type: none"> * Cost * Economic loss 	NRA/ Riparian interest/ fishing clubs	
21	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 three 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
22	Illegal exploitation of salmonids.	<ul style="list-style-type: none"> * Rigorous and high profile enforcement on prolific rivers. 	<ul style="list-style-type: none"> * Protect stocks. 	<ul style="list-style-type: none"> * Cost 	NRA	MAFF

No	Issue	Options	Advantages	Disadvantages	Responsibility	
23	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: * Cost	NRA NRA NRA	
24	Poor salmonid recruitment on the River Wolf.	<ul style="list-style-type: none"> * Continuation of Roadford Operational and Environmental Study 	<ul style="list-style-type: none"> * Provide data to help plan remedial work 	* Cost	NRA SWWSL	
25	Pipe Bridge 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. 	* Cost	NRA	CCC riparian owner?
26	Poor salmonid juvenile densities on the River Claw, upper Henford Water, Luckett Stream and the Ogbear Stream.	<ul style="list-style-type: none"> * Investigation into possible causes and remedial work 	<ul style="list-style-type: none"> * Optimising the fishery 	* Cost	NRA	
27	Continued monitoring of otters to ensure the species and its habitats are protected.	<ul style="list-style-type: none"> * Otter recording; monitoring and post mortem examinations. 	<ul style="list-style-type: none"> * Establish success of work and benefit of expenditure. 	* Resources	NRA Vincent Wildlife Trust/ Other conservation bodies	

No	Issue	Options	Advantages	Disadvantages	Responsibility	
28	Assess the extent and impact of invasive species.	<ul style="list-style-type: none"> * Assess extent and impact on NRA owner 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. 	NRA/	land owners FWAG/ MAFF
29	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"> * Cost 	NRA LPAs/ DAU/ CAU	LPAs/ DAU/ CAU English Heritage
30	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"> * Voluntary in nature * 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"> * Resources * Potential conflict with established users and conservation interests. * Resources 	LPAs/ LPAs/ landowners/ fishing clubs NRA CoCo Land owners NRA	Conservation bodies Land owners/ LPAs/ Public/ Bodies/ CoCo NRA

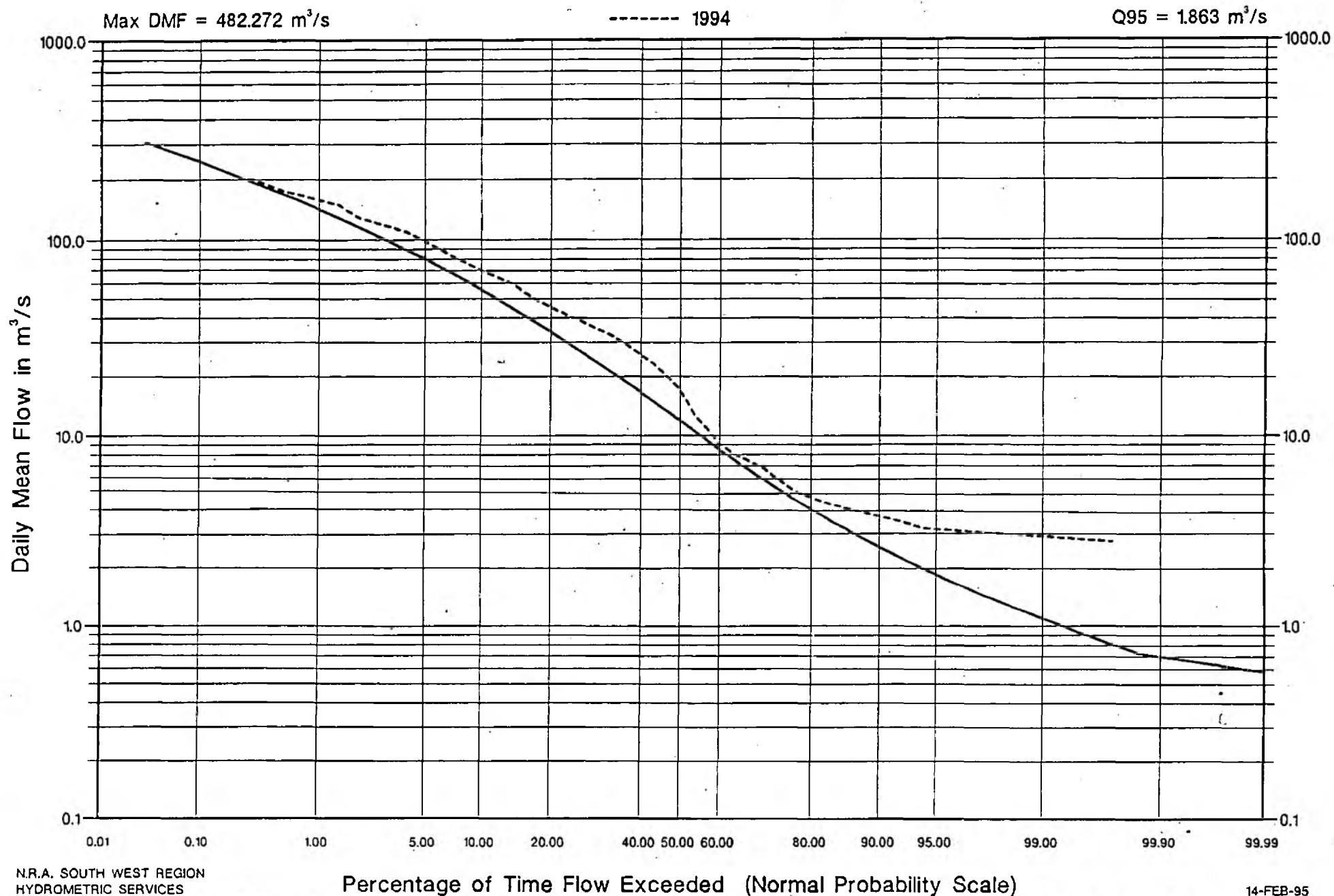
No	Issue	Options	Advantages	Disadvantages	Responsibility	
31	To help promote the responsible use of the River Tamar by canoeists	<ul style="list-style-type: none"> * Promote access agreements * Provision of notice boards on riverside to publicise agreements. * Improved Access/Exit points. 	All Options: <ul style="list-style-type: none"> * Control access through responsible organisations. 	<ul style="list-style-type: none"> * None known. * Cost * Cost 	BCU BCU/NRA BCU/NRA	Riparian owners/ NRA
32	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
33	Increased surface water runoff to Lowley Brook	<ul style="list-style-type: none"> * Planning of development to prevent excess runoff 	<ul style="list-style-type: none"> * No overloading of Lowley Brook 	<ul style="list-style-type: none"> * Cost 	NRA	NCDC/ Developer
34	New development in flood plains.	<ul style="list-style-type: none"> * Planning of development to prevent flooding. 	<ul style="list-style-type: none"> * No additional flooding problems. 	<ul style="list-style-type: none"> * Cost 	District Councils	NRA/ Developer

APPENDICES

Figure A1

RIVER TAMAR AT GUNNISLAKE

FLOW DURATION CURVE 1957-1994



APPENDIX A

HYDROLOGY

The Tamar catchment is mainly surface water fed with several large rivers with catchment areas in excess of 100 km² feeding into the River Tamar.

An analysis of the 37 year record for Gunnislake gauging station indicates a mean daily flow of 22.495 m³/s, a measured Q95 flow (the flow exceeded for 95% of the time on average) of 1.863 m³/s, which represents 8% of the mean daily flow (see Figure A1)

This percentage is relatively low and reflects the flashy nature of this river system and the response of surface waters to rainfall, the soil, subsoil and (limited) groundwater storage availability within the catchment. The major river tributaries, particularly the Ottery and Thrushel are also flashy, although only the Inny and Lyd rise on the moorland granite of Bodmin and Dartmoor.

Floods are characterised by a rapid rise in river levels, high flood peaks and relatively steep recession curves. The maximum daily mean flow at Gunnislake, 482.272 m³/s and the maximum instantaneous flow, 714.570 m³/s were recorded on 27 December 1979 and 28 December 1979 respectively (see Figure A2). These high flows naturally affected the Flow Duration Curve (see Figure A3).

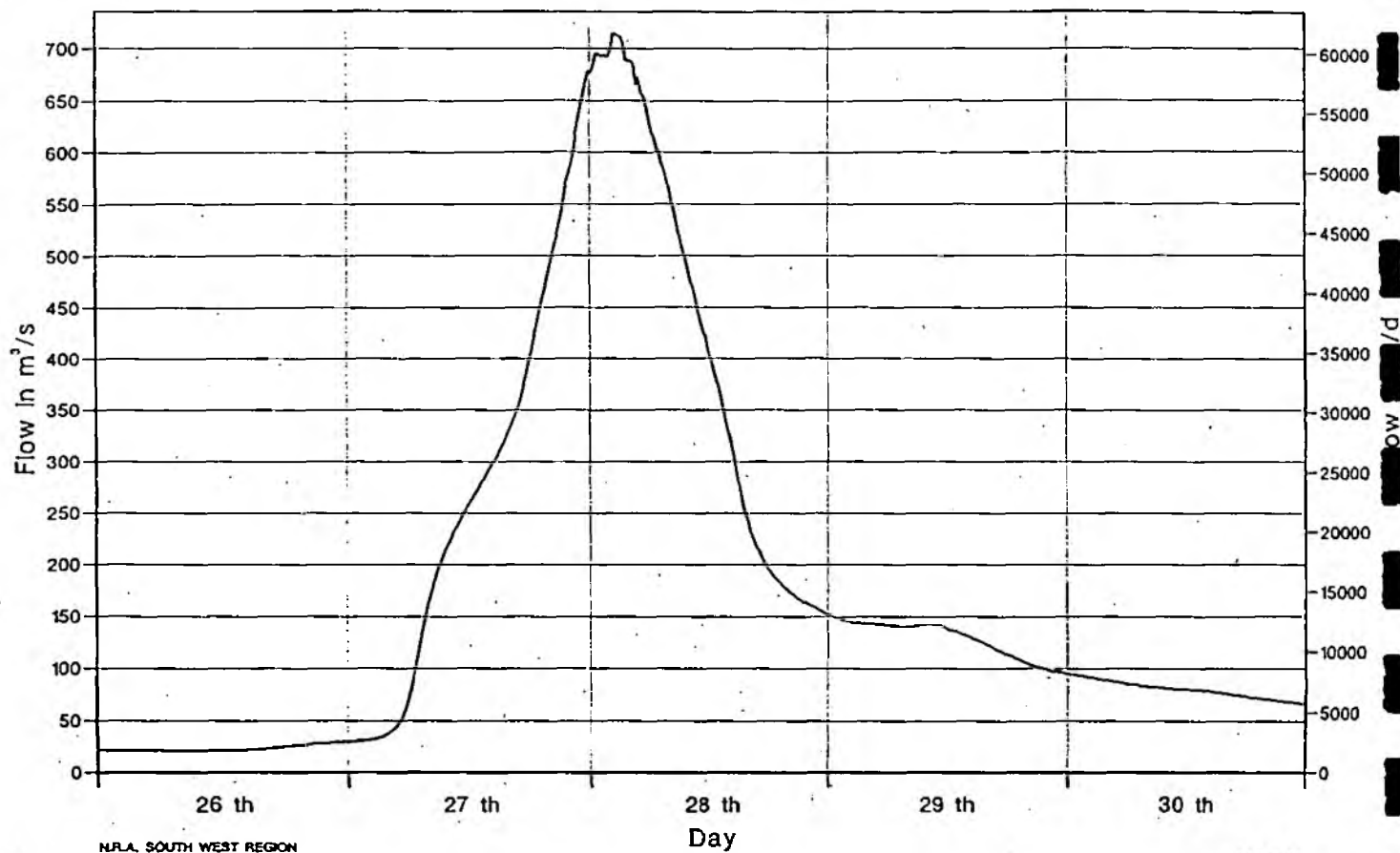
The Tamar has been affected by the construction of Roadford Reservoir on the River Wolf in the 1980s. Comparison of the pre- and post-construction flow duration curves (see Figures A4 and A5) for Gunnislake gauging station show increased flows at the lower end as would be expected with the compensation releases from Roadford. Water is released from the reservoir and subsequently abstracted from the river at Gunnislake for public water supply. As the abstraction point is downstream of the gauging station this is reflected in the flow duration curves. There has been an increase in Q95 between the pre- and post-construction period and the overall period of record shown in Figure A1. Studies are underway to finalise detailed reservoir operating rules. The compensation release from Roadford is currently 0.104 m³/s.

The minimum flow at Gunnislake, recorded on 23 August 1976, was 0.581 cumecs, 2.6% of the mean daily flow (see Figure A9). Although flows fall below the Q95 value for about 18 days per year on average, in the drought years of 1976, 1984 and 1989 flows were at this level for 97, 82 and 59 days respectively (see Figures A6 and A8). By 1990 the benefits of Roadford Reservoir were being felt and the number of days with flows less than Q95 was 2, far less than in previous drought years (see Figure A7).

Upper Tamar Lakes are situated within the headwaters of the Tamar catchment. The compensation release from Tamar Lakes is currently 0.032 m³/s. Flows at Crowford Bridge gauging station some 14 km downstream indicate the effects of the lakes on river flow pattern (see Figure A11), damping out high peak flows. Water is abstracted from the lakes for public water supply.

Figure A2

RIVER TAMAR AT GUNNISLAKE HYDROGRAPH 26.12.1979 - 30.12.1979

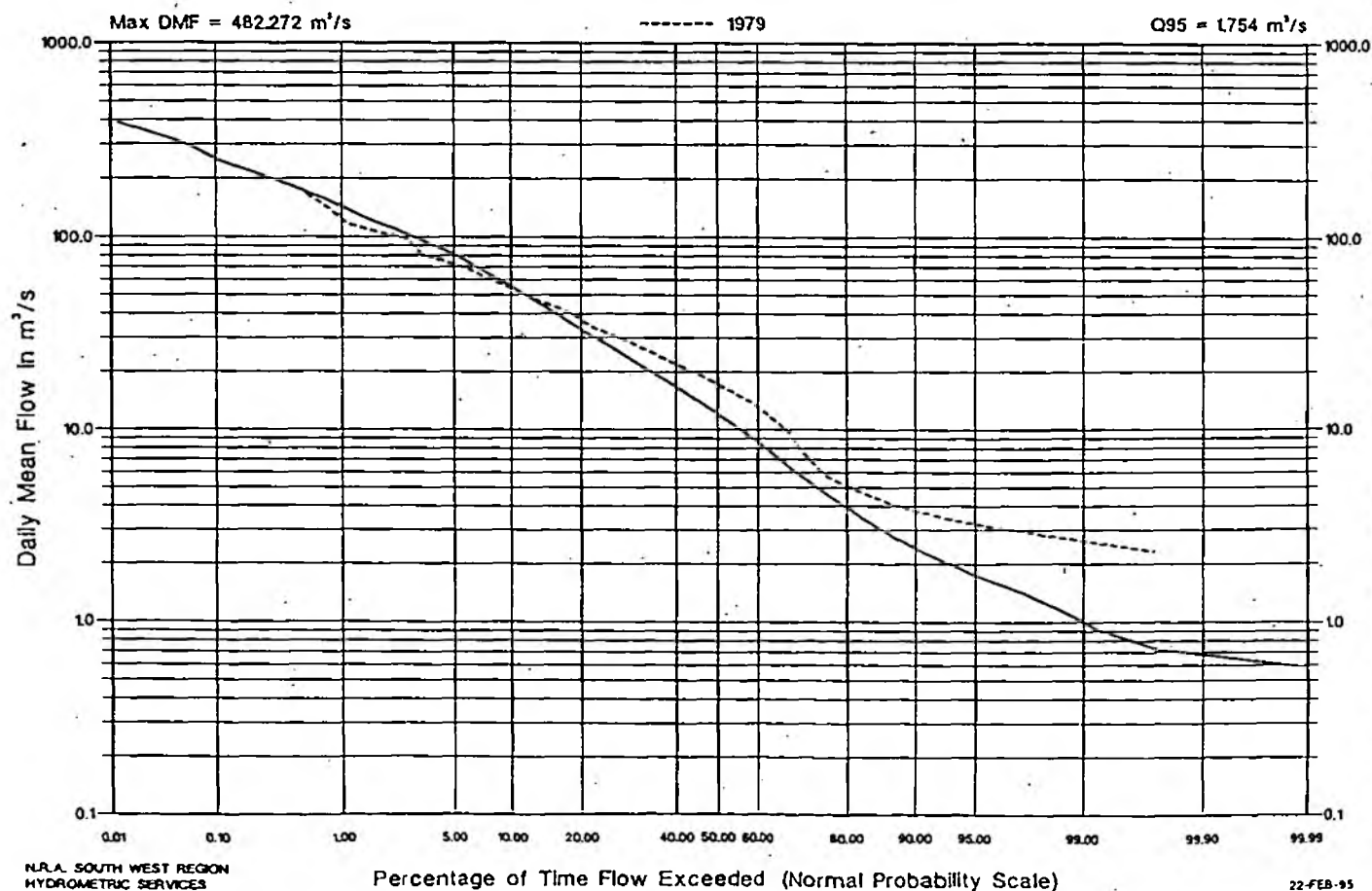


N.R.A. SOUTH WEST REGION
HYDROMETRIC SERVICES

23-FEB-95

Figure A3

RIVER TAMAR AT GUNNISLAKE FLOW DURATION CURVE 1957-1979



N.R.A. SOUTH WEST REGION
HYDROMETRIC SERVICES

Percentage of Time Flow Exceeded (Normal Probability Scale)

22-FEB-95

Figure A4

RIVER TAMAR AT GUNNISLAKE

FLOW DURATION CURVE 1957-1986

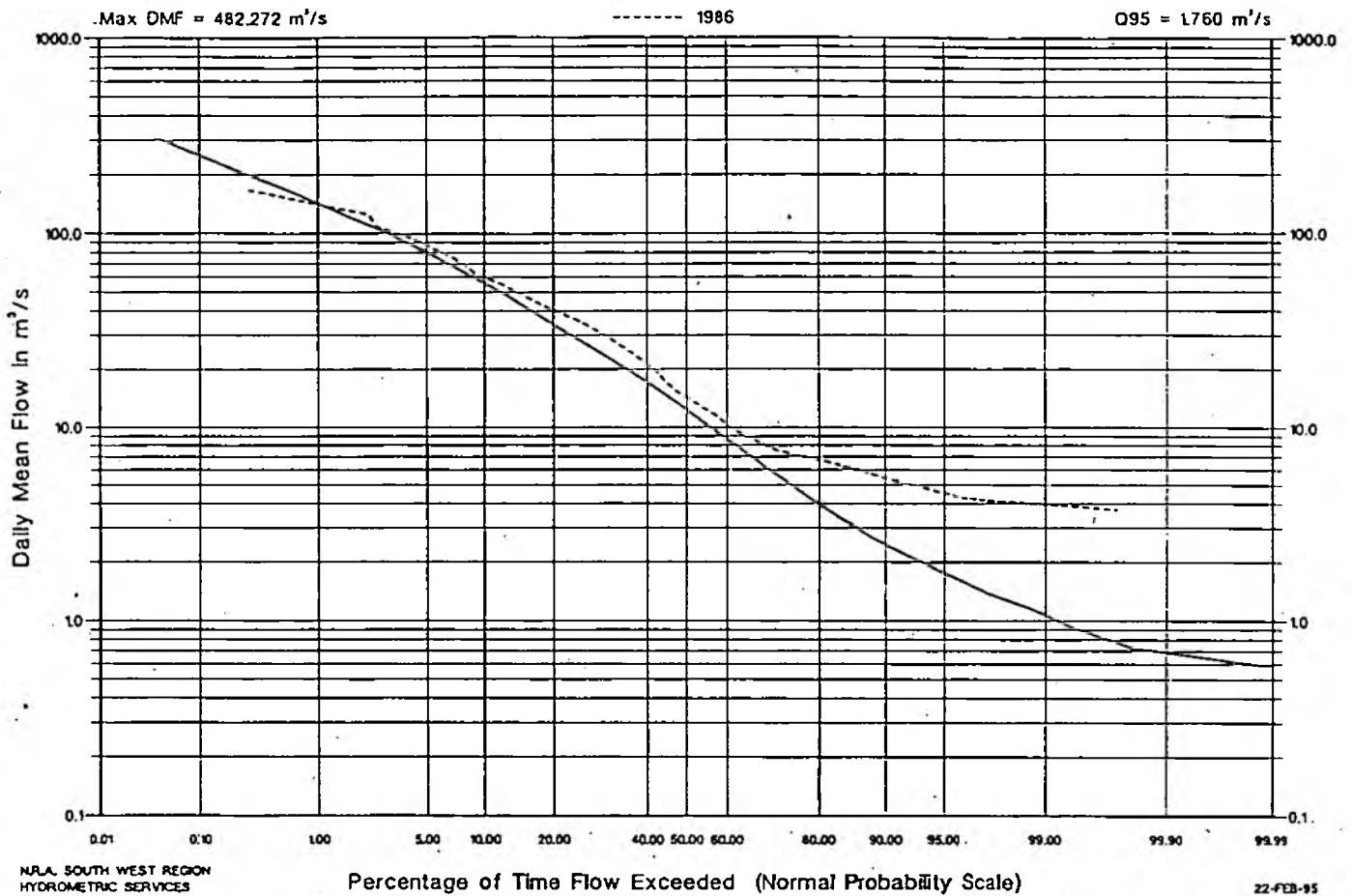


Figure A5

RIVER TAMAR AT GUNNISLAKE

FLOW DURATION CURVE 1988-1994

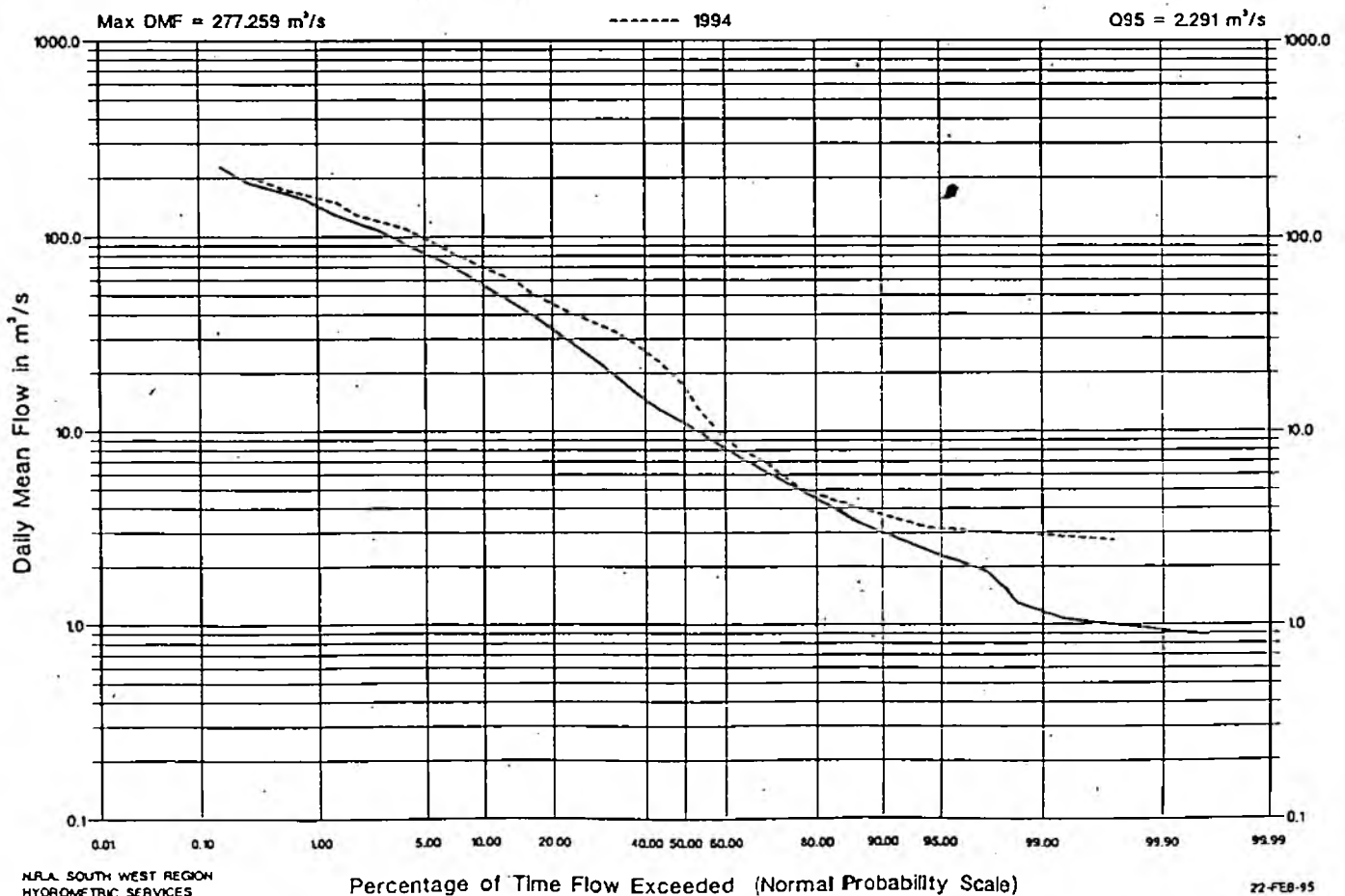


Figure A6

RIVER TAMAR AT GUNNISLAKE

FLOW DURATION CURVE 1957-1976

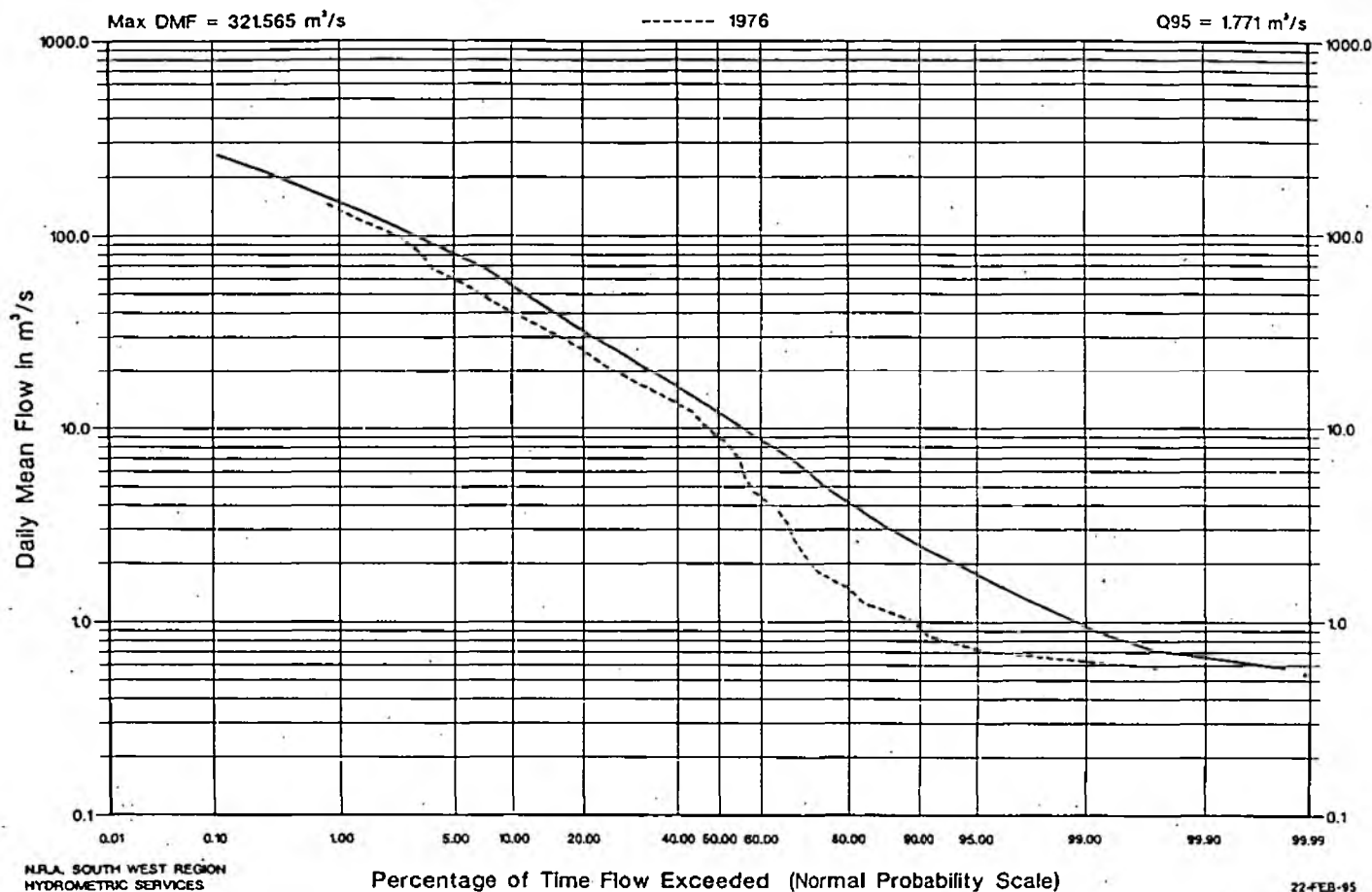


Figure A7

RIVER TAMAR AT GUNNISLAKE

FLOW DURATION CURVE 1957-1990

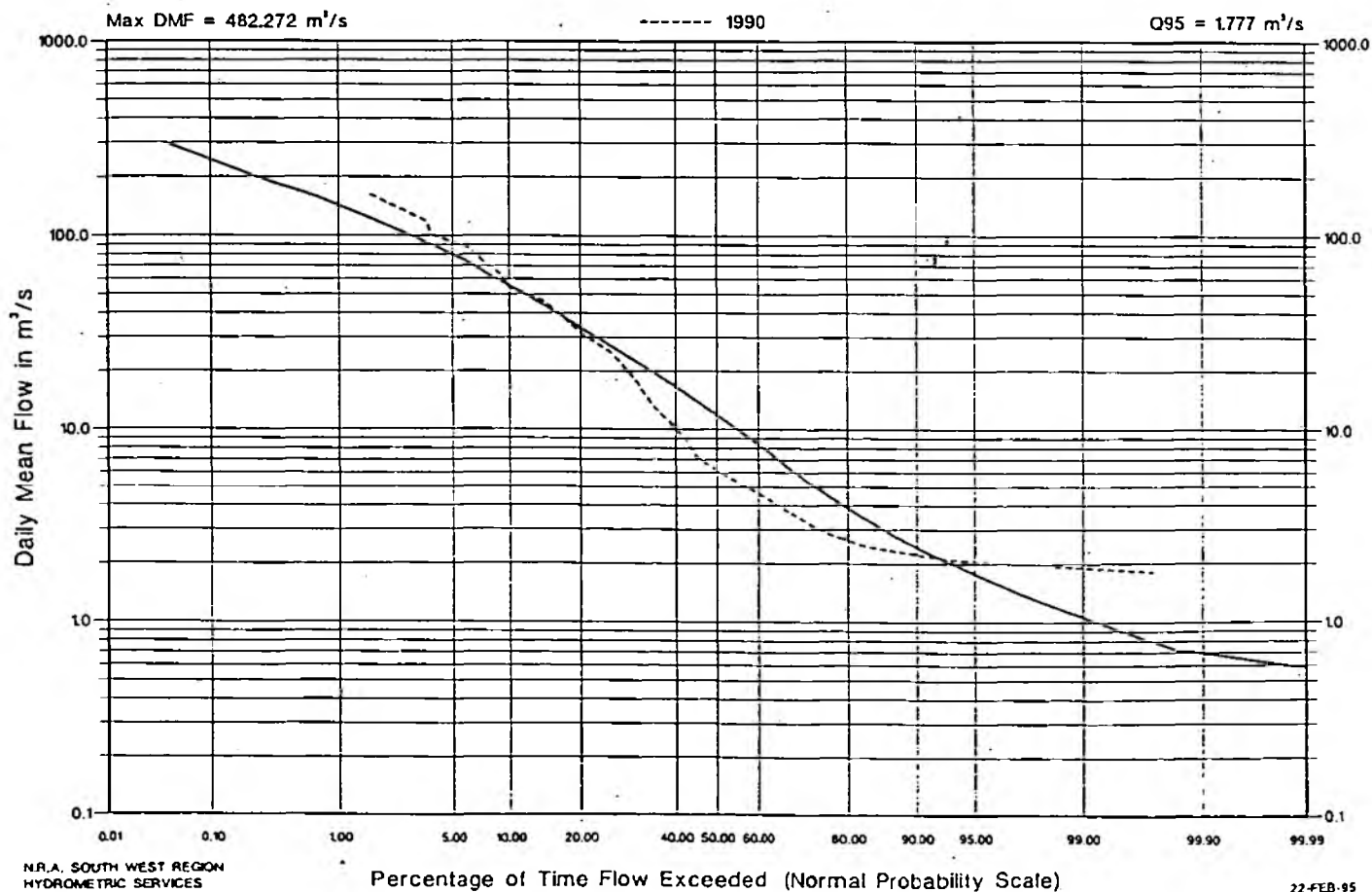


Figure A8

RIVER TAMAR AT GUNNISLAKE

1976

1984

1989

Prescribed flow = 5.523 m³/s

ADF = 22.495 m³/s

Q95 = 1.863 m³/s

— 1989 1984 --- 1976

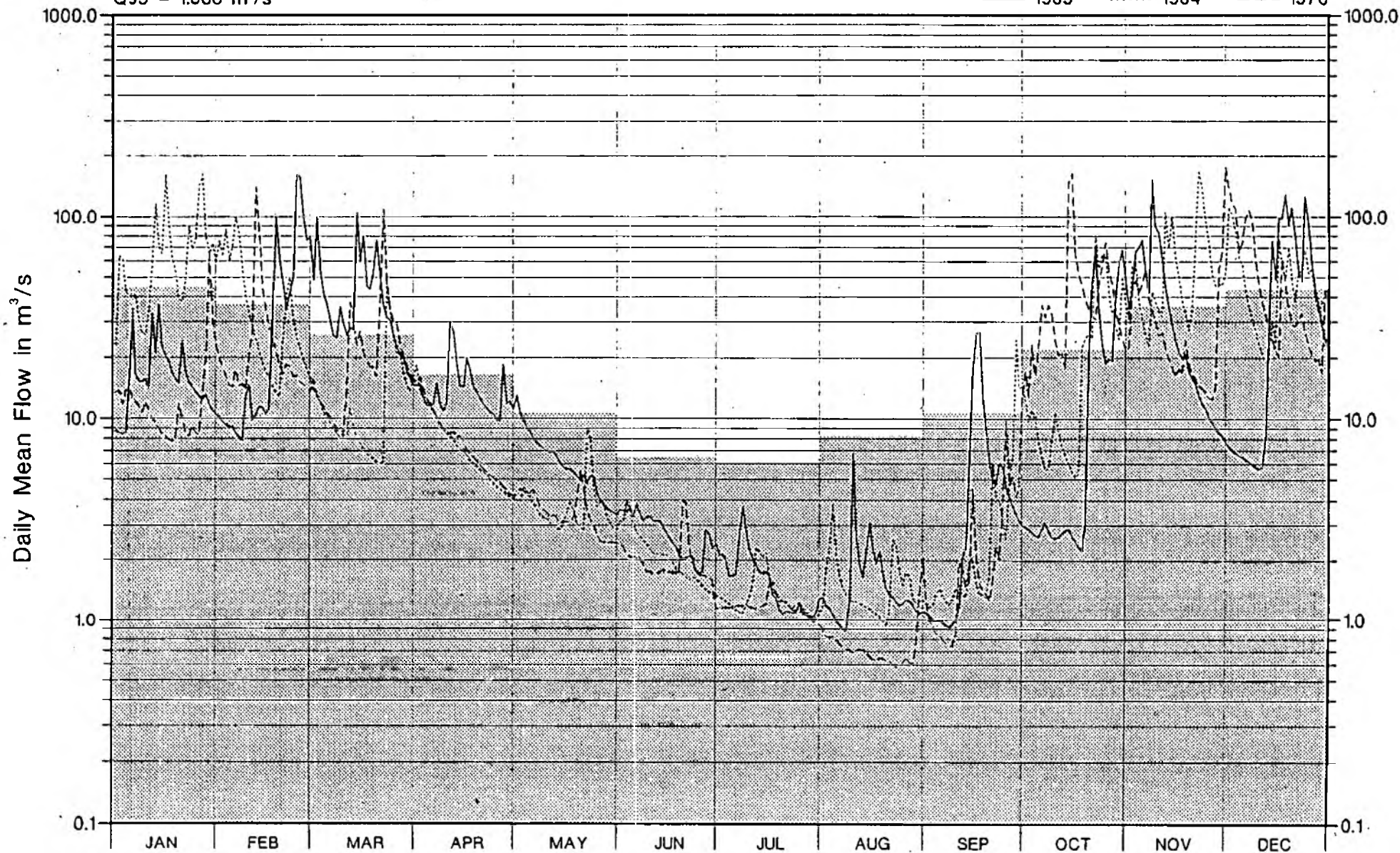


Figure A9

RIVER TAMAR AT GUNNISLAKE

HYDROGRAPH 01.08.1976 - 31.08.1976

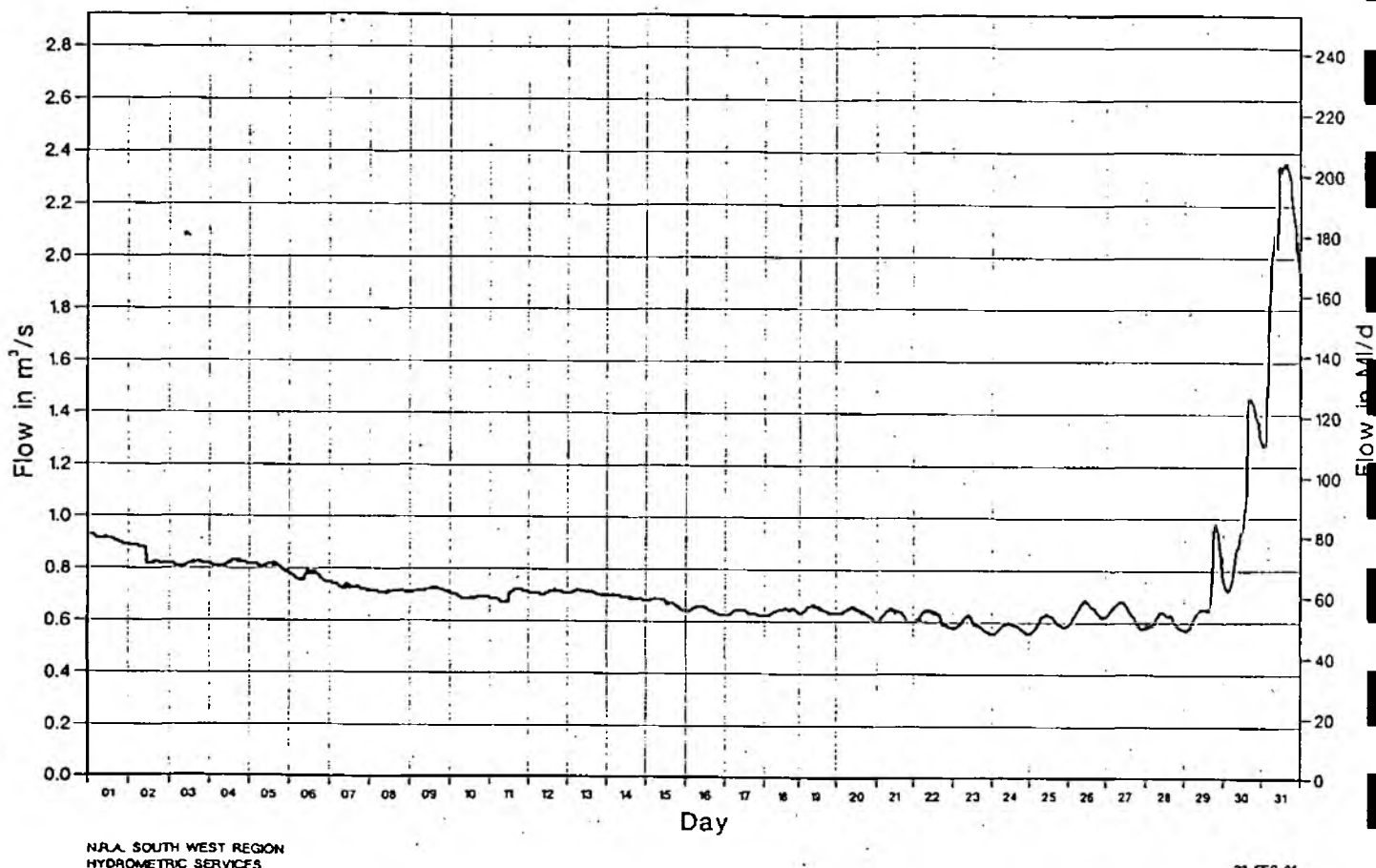
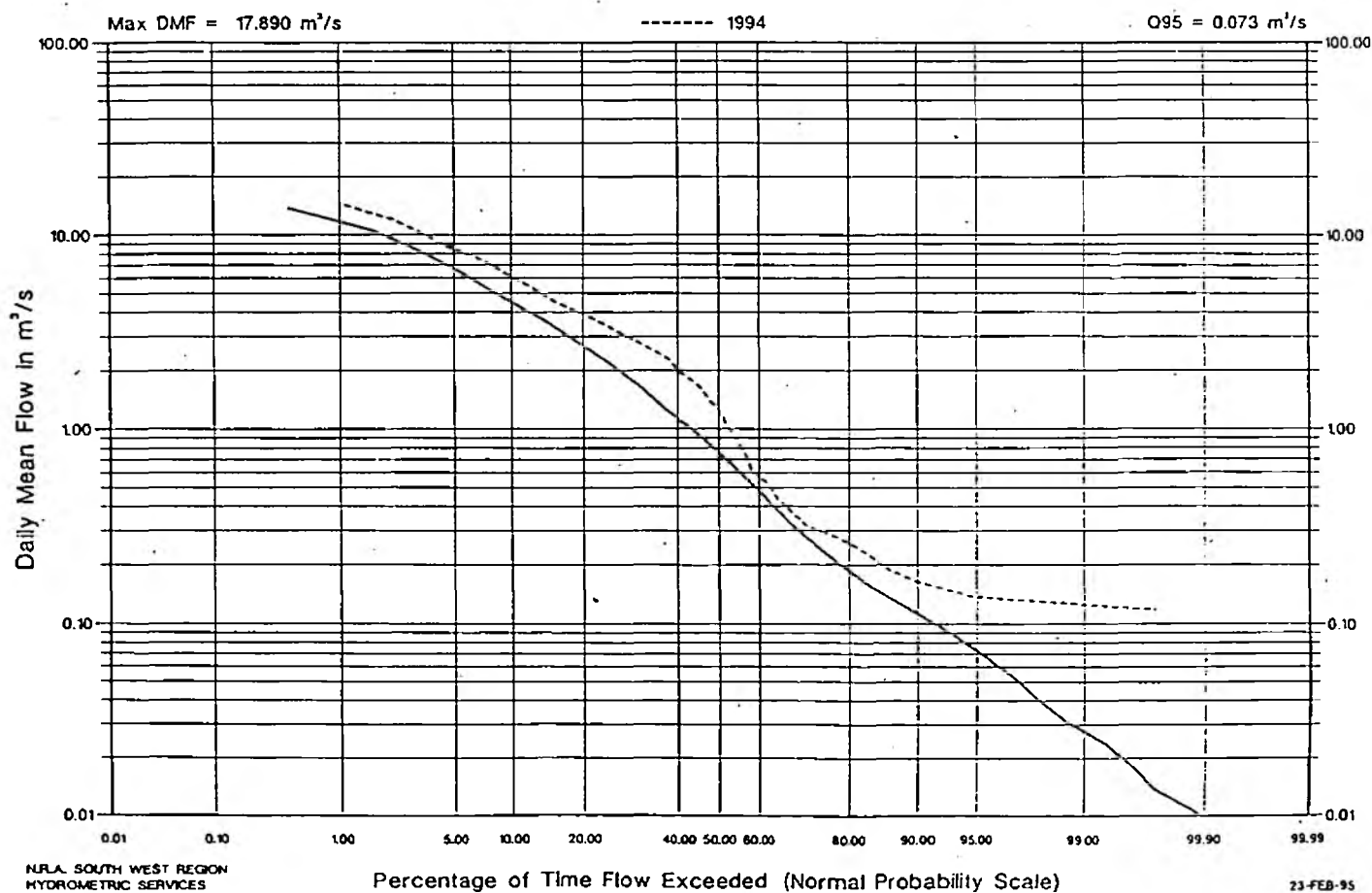


Figure A10

RIVER TAMAR AT CROWFORD BRIDGE

FLOW DURATION CURVE 1973-1994



DRY WEATHER FLOWS

SITE NAME	NGR	DATE	FLOW M ³ /S	DATE	FLOW M ³ /S	DATE	FLOW M ³ /S
1 UPPACOTT	SS 281 124	01/07/75	0.0099	09/08/76	0.006	18/10/94	0.040
2 DEXBEER	SS 295 089	01/07/75	0.0077	09/08/76	0.0033	18/10/94	0.112
3 WRASFORD	SS 267 133	01/07/75	0.0039	09/08/76	0.002	18/10/94	0.019
4 MORETON MILL	SS 276 088	01/07/75	0.0085	09/08/76	0.006	18/10/94	0.049
5 TAMARSTONE	SS 283 055	01/07/75	0.0040	09/08/76	0.0046	18/10/94	0.190
6 HEADON FARM	SS 310 073	01/07/75	0.0023	09/08/76	0.001	18/10/94	0.012
7 YOULDON FARM	SS 299 053	01/07/75	0.0018	09/08/76	0.0003	18/10/94	0.024
8 BRIDGERULE	SS 275 028			09/08/76	0.032	18/10/94	0.262
9 CROWFORD	SS 289 991	01/07/75	0.0292	09/08/76	0.040	18/10/94	0.295
10 MONKS FARM	SS 303 021	01/07/75	0.0019	09/08/76	NIL	18/10/94	0.010
11 YEOMADON FARM	SS 301 005	01/07/75	0.0034	09/08/76	TRICKLE	18/10/94	0.021
12 NORTH TAMARTON	SS 318 974	01/07/75	0.0445	09/08/76	0.040	18/10/94	0.352
13 A3072 BRIDGE	SS 335 042			09/08/76	0.007	18/10/94	0.054
14 DERRITON	SS 335 032			09/08/76	0.015	18/10/94	0.056
15 WINSCOTT	SS 339 014	02/07/75	0.0220	09/08/76	0.007	18/10/94	0.086
16 COMMONS GATE	SX 319 974	01/07/75	0.0226	09/08/76	0.007	18/10/94	0.117
17 CLAW BRIDGE	SS 375 004	01/07/75	0.0054	09/08/76	NIL	18/10/94	0.022
18 CLAWTON	SX 353 993	01/07/75	0.0075	09/08/76	NIL	18/10/94	0.034
19 TETCOTT BRIDGE	SX 327 969	01/07/75	0.0125	09/08/76	NIL	18/10/94	0.045
20 BOYTON BRIDGE	SX 328 923	01/07/75	0.1029	09/08/76	0.060	18/10/94	0.500 EST
21 BRIDGETOWN	SX 343 891	01/07/75	0.0015	09/08/76	NIL	18/10/94	0.032
22 CROSSGATE	SX 343 886	01/07/75	0.1186	10/08/76	0.067	18/10/94	0.555
23 OTTERHAM MILL	SX 173 909	02/07/75	0.020	10/08/76	0.007	18/10/94	0.081

SITE NAME	NGR	DATE	FLOW M ³ /S	DATE	FLOW M ³ /S	DATE	FLOW M ³ /S
24 NEWHAM RHT	SX 180 927	02/07/75	0.049	10/08/76	0.010	18/10/94	0.099
25 NEWHAM LHT	SX 179 928	02/07/75	0.022	10/08/76	0.003	18/10/94	0.029
26 NORTH PETHERWIN	SX 268 889	02/07/75	0.011	10/08/76	NIL	18/10/94	0.077
27 CANWORTHY WATER - OTTERY	SX 224 917	02/07/75	0.061	10/08/76	0.013	18/10/94	0.191
28 CANWORTHY WATER - RHT	SX 224 915	02/07/75	0.024	10/08/76	0.013	18/10/94	0.111
29 CANWORTHY WATER - LHT	SX 226 918	02/07/75	0.003	10/08/76	NIL	18/10/94	0.029
30 HELLESCOTT BRIDGE	SX 285 877	02/07/75	0.083	10/08/76	0.024	18/10/94	0.462
31 NAVARINO	SX 289 893	02/07/75	0.004	10/08/76	NIL	18/10/94	0.050
32 WERRINGTON PARK	SX 336 866	03/07/75	0.080	10/08/76	0.022	18/10/94	0.646
33 NETHERBRIDGE	SX 349 867	03/07/75	0.187	10/08/76	0.066	18/10/94	1.230
34 ASHMILL	SX 393 953	01/07/75	0.022	10/08/76	0.001	19/10/94	0.130 *
35 VIRGINSTOWE	SX 372 926	01/07/75	0.025	10/08/76	0.002	18/10/94	0.242
36 BOLDFORD BRIDGE	SX 363 883	01/07/75	0.024	09/08/76	0.001	24/10/94	0.440 *
37 HEALE BRIDGE	SX 360 863	03/07/75	0.031	09/08/76	0.001	24/10/94	0.501 *
38 EGLOSKERRY	SX 268 865			09/08/76	0.012	18/10/94	0.091
39 TREWITTHICK FARM	SX 299 850	02/07/75	0.007	09/08/76	0.040	18/10/94	0.177
40 LAUNCESTON - KENSEY	SX 351 848			09/08/76	0.045	18/10/94	0.278
41 A386 BRIDGE	SX 520 845	03/07/75	0.065	11/08/76	0.030	19/10/94	0.182 *
42 GREEN LANES - LYD	SX 444 833	03/07/75	0.095	11/08/76	0.049	19/10/94	0.375 *
43 BRIDESTOWE BRIDGE	SX 515 894	03/07/75	0.017	11/08/76	0.011	19/10/94	0.072 *
44 LEWMILL	SX 469 862	03/07/75	0.108	11/08/76	0.056	19/10/94	0.422 *
45 GREEN LANES - LEW	SX 441 834	03/07/75	0.172	11/08/76	0.079	19/10/94	0.528 *
46 WRXHILL BRIDGE	SX 465 898	03/07/75	0.004	11/08/76	NIL	24/10/94	0.305 *

SITE NAME	NGR	DATE	FLOW M ³ /S	DATE	FLOW M ³ /S	DATE	FLOW M ³ /S
47 STOWFORD BRIDGE	SX 428 873	03/07/75	0.015	11/08/76	0.002		
48 ROADFORD	SX 425 908	03/07/75	0.009	11/08/76	NIL	24/10/94	0.428 *
49 REXON CROSS	SX 413 888	03/07/75	0.010	11/08/76	NIL	24/10/94	0.594 *
50 TINHAY	SX 398 856	03/07/75	0.048	11/08/76	0.009	19/10/94	0.960
51 LIFTON PARK	SX 388 842	03/07/75	0.385	11/08/76	0.187	19/10/94	1.870
52 LOWLEY BRIDGE	SX 359 788	02/07/75	0.021	11/08/76	0.004	19/10/94	0.453 EST
53 TREGLASTRA	SX 180 859	02/07/75	0.071			19/10/94	0.225 *
54 LANEAST	SX 225 835	02/07/75	0.134	11/08/76	0.098	19/10/94	0.503 *
55 TWO BRIDGES - INNY	SX 269 818	02/07/75	0.160	11/08/76	0.111	19/10/94	0.524 EST
56 ALTARNUN	SX 223 813	02/07/75	0.067	11/08/76	0.048	19/10/94	0.552 *
57 TWO BRIDGES - PENPONT	SX 269 818	02/07/75	0.112	11/08/76	0.060	19/10/94	0.336 EST
58 TREKELLAND BRIDGE	SX 300 799	02/07/75	0.357	11/08/76	0.166	19/10/94	1.466 *
59 BEALSMILL	SX 359 771	02/07/75	0.405	11/08/76	0.257	19/10/94	1.820 *
60 HORSEBRIDGE	SX 400 748	03/07/75	1.271	11/08/76	0.644		
61 LUCKETT	SX 389 736	03/07/75	0.042	11/08/76	0.035	19/10/94	0.119 *
62 BLANCHDOWN	SX 414 737	03/07/75	0.013	11/08/76	NIL	19/10/94	0.059 *
63 GUNNISLAKÉ	SX 426 725	03/07/75	1.328	11/08/76	0.734	19/10/94	6.201 *

* - Significant rainfall before these gaugings
EST - Flow figures derived from other local gaugings

APPENDIX B

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 Tormentil (*Potentilla erecta*), Devils-bit Scabious (*Succisa pratensis*) and Creeping Willow (*Salix repens*). Bryophytes are also represented including *Campyllum 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 Stitchwort (*Stellaria alsine*), Ragged Robin (*Lychnis flos-cuculi*) and Meadow Sweet (*Filipendula ulmaria*).

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, Lockett

- 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 C

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).

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. In 1993 salmon fry were recorded above Ashmill weir at two sites for the first time. 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.

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.

Ogbear 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 Dameral Stream and a reasonable trout population. No salmon and a very low trout density in the River Lockett 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 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.

[illegible]

RIVER	SITE	NGR	DATE	SURVEY	CLUSTER	POPULATION DENSITIES (No / 100m2)				OTHER SPECIES
						TROUT 0+	TROUT ->1+	SALMON 0+	SALMON ->1+	
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
	Gulliver Bridge	SS33560503	27/06/93	1 RUN	X	0.6	7.2	0	0	B,SL,M,L
	Derinton Bridge	SS33750325	26/06/93	1 RUN	Y	0	9.4	0	0	B,SL,M
	Winecott 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	SX32579680	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

						POPULATION DENSITIES (No / 100m2)				
RIVER	SITE	NOR	DATE	SURVEY	CLUSTER	TROUT 0+	TROUT =>1+	SALMON 0+	SALMON =>1+	OTHER SPECIES
DOWN STREAM	Bednallick	SX35209933	28/06/93	1 RUN	V	4.3	0	0	0	E,B,SL,M,L
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
	Luffincott	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
	Eggboare	SX34108914	30/06/93	3 RUN	*	0	6.9	0	0	E,B,SL,M,L
OTTERY	Osterham Mill	SX17509110	23/07/93	1 RUN	AQ	81.3	9.3	39.3	1.8	E,B,SL
	Trevillian	SX18009265	07/07/93	3 RUN	AQ	33.8	16.9	83.5	7.3	B, ML
	U/S 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
	Camworthy Water	SX22859170	10/08/93	3 RUN	AR	0	5.4	48.1	10.0	E,B,SL,M,L
	Bray Wood	SX23809010	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
	Penheale	SX27168865	18/08/93	1 RUN	AS	0	3.7	22.5	2.3	E,B,SL,M,L
	Hellewott	SX29108758	20/08/93	1 RUN	AS	0.1	7.2	12.5	3.2	E,B,SL,M,L,ST
	Yedm Bridge	SX31108735	19/08/93	3 RUN	AS	0.2	6.3	7.0	3.1	E,B,SL,M,L,ST
	Wernington 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

RIVER	SITE	NGR	DATE	SURVEY	CLUSTER	POPULATION DENSITIES (No / 100m2)				OTHER SPECIES
						TROUT 0+	TROUT ->1+	SALMON 0+	SALMON ->1+	
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 247 927	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
BOLESBRIDGE	Bolesbridge	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, M,L
	Ashmill 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
	Baldford Bridge	SX36458837	03/09/93	1 RUN	T	0	9.6	9.7	1.2	E,B,SL,M,L
	Beale Bridge	SX35948624	02/09/93	3 RUN	T	0	5.9	4.6	4.7	E,B,SL,M,L
COOKWORTHY STR	Cookworthy Buckle	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 Varn Bridge	SX37859667	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	Bedgill	SX23038695	08/06/93	3 RUN	AO	100.0	10.2	18.6	0	E, L
	Treburrow	SX25458730	22/06/93	1 RUN	AO	13.7	10.0	0.9	0	B,SL, L
	Egloskeny	SX26658645	22/06/93	1 RUN	AO	9.5	8.3	10.4	1.3	B,SL, L
	Tredidon	SX28368513	22/06/93	1 RUN	AO	0.5	9.1	4.4	0.4	B, L
	Trewithic	SX29558494	23/06/93	1 RUN	AH	2.1	12.3	7.5	1.8	E,B, M,L,O
	New Churches	SX32258508	23/06/93	3 RUN	AH	1.5	7.3	0.3	3.0	E,B, M,L,O
	St Leonards	SX34788470	23/06/93	1 RUN	AH	0	4.1	1.9	1.2	E,B,SL,M,L

						POPULATION DENSITIES (No / 100m2)				
RIVER	SITE	NOR	DATE	SURVEY	CLUSTER	TROUT 0+	TROUT ->1+	SALMON 0+	SALMON ->1+	OTHER SPECIES
BADHARLICK STR	Down Stream	SX26588620	10/06/93	1 RUN	AO	49.7	14.8	9.8	0	B,SL, L
LYD	Langham	SX48008353	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	Ebbford	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
	Parcombe	SX47908745	04/08/93	2 RUN	AK	4.9	11.0	35.8	3.3	E,B,SL,M,L,ST
	Lew Mill	SX47008622	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,G,ST
	Lee	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
THRUSHFEL	Ostrell	SX51509230	29/07/93	1 RUN	AM	7.6	17.9	0.3	0	B,SL, L
	Orest 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	Burdon Bridge	SX33558190	01/07/93	1 RUN	AF	7.3	7.9	0	0.5	E,B,SL, L

[illegible]

						POPULATION DENSITIES (No. / 100m ²)				
RIVER	SITE	NGR	DATE	SURVEY	CLUSTER	TROUT 0+	TROUT ->1+	SALMON 0+	SALMON ->1+	OTHER SPECIES
BUDDLE BROOK	Horsebridge	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

Key

•	no cluster	D	doce	E	ed
A	absent	R	roach	B	bullhead
P	present	O	grayling	SL	stone loach
**	adipose fin-clipped fish recorded	ST	adult sea trout	M	minnow
BTAFC	stocked trout adipose fin dip	SS	adult salmon	L	brook lamprey
BTAFC(B5)	stocked trout - AFC - blue dye mark left pelvic fin				
BTAFC(BC)	stocked trout - AFC - blue dye mark on caudal peduncle				

Summary Results of River Lyd Electric-fishing Survey 1993

RIVER	SITE	NOR	DATE	SURVEY	CLUSTER	TROUT 0+	TROUT ->1+	SALMON 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	5.2	51.7	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	
	Spy Farm	SX 406 852	16/08/93	1 RUN	A	0.0	1.3	54.0	10.5	B,SL,M	
	Lifton Playing Field	SX 392 850	20/08/93	1 RUN	A	0.0	3.5	33.9	16.5	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	
	U/S Gatherley	SX 380 841	26/08/93	1 RUN	A	0.0	2.0	41.5	20.3	E,B,SL,M,OR(97mm)	
	D/S Gatherley	SX 377 840	Not Surveyed								Engineering work
THRUSHEL	Waxhill Bridge	SX 467 899	11/08/93	1 RUN	B	0.0	6.2	3.3	0.3	B,SL,M	
	Thrushelton	SX 445 891	10/08/93	3 RUN	B	0.0	5.1	18.1	0.4	E,B,SL,M	
	Townleigh	SX 426 872	06/08/93	1 RUN	B	1.3	3.9	16.5	0.3	E,B,SL,M	
	D/S Hayne Bridge	SX 416 866	18/08/93	3 RUN	C	0.0	7.0	1.5	2.6	E,B,SL,M,L	
	Tinbury	SX 402 857	19/08/93	1 RUN	C	0.3	1.0	19.4	2.2	E,B,SL,M,L	
	Tinbury Bridge	SX 395 855	17/08/93	1 RUN	C	0.2	0.6	64.6	2.5	E,B,SL, L	
WOLF	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(B5) 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
	D/S Kellecott	SX 405 876	02/08/93	1 RUN	E	1.1	1.9	17.1	0.5	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	
	U/S Cookworthy Trap	SX 404 865	04/08/93	1 RUN	E	0.5	5.4	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	Upcott Mill	SX 404 897	01/08/93	1 RUN	F	0.0	2.3	6.6	0.0	B,SL	
	Drownmill	SX 406 876	01/08/93	3 RUN	F	0.0	2.0	3.4	0.0	B,SL	

Summary Results of Upper Tamar ALF Electric-fishing Survey 1993

RIVER	SITE	NGR	DATE	SURVEY	CLUSTER	POPULATION DENSITIES (No / 100m ²)				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
	Dexbeer	SS 294 089	02/06/93	1 RUN	AA	0	1.1	0	0	E, SL,M
	Moreton Mill	SS 284 086	04/06/93	DIP	*	A	P	P	A	E,B,SL,M,R
	Orest Moreton	SS 281 071	19/08/93	DIP	*	P	P	P	P	E,B,SL,M
	Tamarstone	SS 283 054	04/06/93	3 RUN	AA	0	2.4	0	0.3	E,B,SL,M
	Bridgerule	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	13.3	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 333 911	08/07/93	3 RUN	*	0	0.6	1.6	0	E,B,SL,M,O
	Dexbeer	SS 294 089	31/08/93	3 RUN	*	0	0.9	1.8	0	E, SL,M
	Tamarstone	SS 283 054	01/09/93	3 RUN	*	0	2.0	0.6	1.1	B,SL,M
	Bridgerule	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	0.3	0	EB,SL,ML
	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 Trapoyte Fm	SX 302 986	07/09/93	1 RUN	AD	0.3	2.3	8.6	0	B,SL,M,L
	D/S Trapoyte 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	1.3	B,SL,M,G
	U/S N.Tamerton(B)	SX 316 975	02/09/93	1 RUN	AE	0	0	8.8	0	EB,SL,M,G
	North Tamerton	SX 317 975	01/09/93	3 RUN	AE	0	3.1	1.0	1.6	B,SL,M
	D/S N.Tamerton(A)	SX 319 969	02/09/93	1 RUN	AE	0	0	7.3	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

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 D
WATER QUALITY TABLES

TABLE 1 : 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

TABLE 2: 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'	'I'	'G'	'I'
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.				

TABLE 3: 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

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

Table 3 continued

Parameter	Units	Value (3)		Hardness (mg CaCO ₃ /l)	Status (2)
		A Sm	B Sm		
Lead	µg Pb/l	4	50	0 to 50	AA,D
		10	125	50 to 100	
		10	125	100 to 150	
		20	250	150 to 200	
		20	250	200 to 250	
		20	250	>250	
Chromium	µg Cr/l	5	150	0 to 50	AA,D
		10	175	50 to 100	
		20	200	100 to 150	
		20	200	150 to 200	
		50	250	200 to 250	
		50	250	>250	
Zinc	µg Zn/l	8	75	0 to 50	AA,T
		50	175	50 to 100	
		75	250	100 to 150	
		75	250	150 to 200	
		75	250	200 to 250	
		125	500	>250	
Copper	µg Cu/l	1	1	0 to 50	AA,D
		6	6	50 to 100	
		10	10	100 to 150	
		10	10	150 to 200	
		10	10	200 to 250	
		28	28	>250	
Nickel	µg Ni/l	50	50	0 to 50	AA,D
		100	100	50 to 100	
		150	150	100 to 150	
		150	150	150 to 200	
		200	200	200 to 250	
		200	200	>250	
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	20	0 to 200	AA,T
		60	60	200+	
Tributyltin	µg/l	0.02		All	M,T
Triphenyltin	µg/l	0.02		All	M,T
Polychlorochlormethyl- 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

Parameter	Units	Value (3)		Hardness (mg CaCO ₃ /l)	Status (2)
		A Std	B Std		
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

TABLE 4: 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 4 Continued

CHARACTERISTICS OF SURFACE WATER INTENDED FOR THE ABSTRACTION OF DRINKING WATER			CATEGORIES					
			A1		A2		A3	
PARAMETERS			G	I	G	I	G	I
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	$\mu\text{S}/\text{cm}^{-1}$ 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 4 Continued

CHARACTERISTICS OF SURFACE WATER INTENDED FOR THE ABSTRACTION OF DRINKING WATER			CATEGORIES					
			A1		A2		A3	
PARAMETERS			G	I	G	I	G	I
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) paranitraniline 4 aminoantipyrine	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 4 Continued

CHARACTERISTICS OF SURFACE WATER INTENDED FOR THE ABSTRACTION OF DRINKING WATER			CATEGORIES					
			A1		A2		A3	
PARAMETERS			G	I	G	I	G	I
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 5: EC DIRECTIVE CONCERNING URBAN WASTEWATER TREATMENT (91/271/EEC)**Indicative Standards for identifying HNDAs, and defining "No Adverse Affects"¹**

Any site designated as an HNDA must be subject to Comprehensive Studies to be carried out by the discharger, and audited by the NRA, before a consent can be issued for a lower level of treatment.

The comprehensive studies must show that no adverse effects will be caused by discharging a primary rather than a secondary treated effluent within the HNDA. In addition, protection of Bathing Waters and other recognised uses must be considered separately within the scheme design.

Determinand	Indicative Standard		Notes
	Estuaries ²	Coastal Waters	
Minimum Initial Dilution	50	50	
Dilution within 1 nautical mile	≥200	≥200	Based on a post dilution BOD conc of 1mg/l
Dissolved oxygen: change caused by discharge (mg/l)	≤1	≤0.5	Based on a predicted median DO of ≥7mg/l ³
BOD: deviation from background (mg/l)	-	<1.5	
Area must not be eutrophic	-	<1µg/l of chlorophyll ascribed to discharge	
Marine Communities	-	No change >100m from outlet	

Notes: ¹ Comprehensive Studies for the purposes of Article 6 of Directive 91/271/EEC. The Urban Waste Water Treatment Directive. Marine Pollution Monitoring Management Group. February 1994.

² The difference in loading from a primary treated effluent compared to a secondary treated effluent from works in the range 2000 to 10000 pe is very small. Therefore only DO is likely to be significantly affected. Therefore this is the main criterion for assessing "no adverse affect" in estuaries.

TABLE 6: 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 E

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 - WINSCOTT 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 Lamberd 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 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

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 and into the raw water transfer main across to Littlehempston WTW in the Dart catchment. A prescribed flow condition operates at this site.

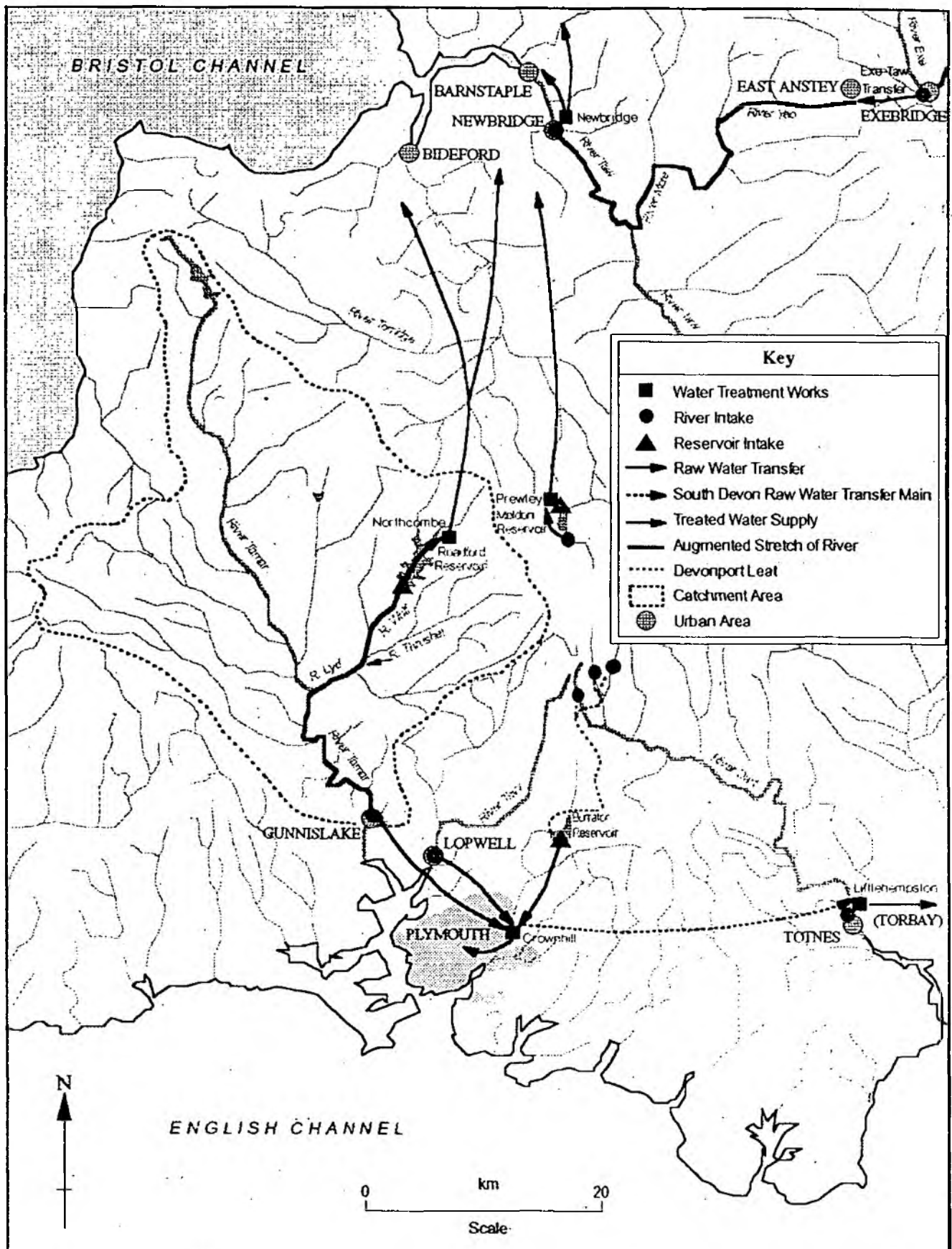
Littlehempston Abstraction (Dart Catchment):

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, the Tavy or the Tamar.

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

Appendix X - The Roadford Supply System



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 2.25Ml/d SWWSL are authorised to abstract up to 9.09Ml/d (subject to a 50% take rule when flows are below 9.09Ml/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.

GLOSSARY

ABSTRACTION

Removal of water from surface or groundwater, usually by pumping.

ADIT

Horizontal entrance into a mine or a horizontal passage.

ALLUVIAL DEPOSITS

Sedimentary deposits resulting from the action of rivers. Typically, fine grained material carried by the river and deposited in areas such as flood plains.

AQUIFER

Layer of porous rock or soil able to hold or transmit water.

AUGMENTATION

The support of a downstream river abstraction by releasing equivalent quantities of water from an upstream source whether it be a reservoir or borehole

BASEFLOW

The flow in a river derived from groundwater sources.

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

Cryptocrystalline silica which may be of organic or inorganic origin. It occurs as bands or layers of nodules in sedimentary rocks.

COMPENSATION FLOW

A prescribed release from a reservoir to compensate for the impact of the impoundment and to maintain 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 two 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 akin to, or like carp 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. An "Ordinary" Drought Order could contain provisions such as; to authorise abstraction from an unlicensed source, override the conditions pertaining to an abstraction licence, limit the amount of water which may be taken from a source or vary discharge conditions. An "Emergency" Drought Order 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.

EVAPOTRANSPIRATION

Loss of water by land plants due to evaporation.

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.

FLUVIAL

Pertaining to river flow and its erosive activity.

FRY

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

GROUND TRUTHING

Investigations to check that the situation on the ground matches desk-top studies.

HYDROGEOLOGY

Branch of geology concerned with water within the Earth's crust.

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 now requiring a licence by virtue of an amendment to Section 24(2) and (3) of the Water Resources Act 1963.

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. jellyfish, snail, fly.

MAIN RIVER

Some, but not all, watercourses are designed as 'Main River'. 'Main River' status of a watercourse must 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 where the country rock has been altered and affected by the heat.

MINIMUM ACCEPTABLE FLOW (MAF)

A prescribed flow in a river set 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).

PARR

PERMEABILITY

The ease at which liquids (or gases) can pass through rocks or a layer of soil.

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 voids to the total volume of the material.

POTABLE

Water of a suitable quality 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 specified in a licence as a condition of abstraction such that abstraction must be reduced or cease if it would reduce the flow downstream to less than the prescribed flow.

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.

RED LIST SUBSTANCE

Substance which has been selected for monitoring on the basis of its persistency, toxicity and ability to bioaccumulate.

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 is generally regarded as the critical historical drought sequence, with a risk of occurrence regionally of approximately 1:50 years.

RESERVOIR PUMPED STORAGE

The supplementation of the natural inflow to a reservoir with river water abstracted downstream of 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 flow. Fast streams on most non-chalk areas have alternating riffles and pools.

RIPARIAN OWNER

Owner of riverbank and/or land adjacent to a river. Normally owns riverbed and rights to 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 prescribed flows in rivers in order to allow abstraction to continue during times of low flow or for environmental protection. This is achieved by a combination of reducing abstraction rates and supporting river flows using upstream sources.

SALMONID

Game fish of the salmon family eg. salmon, trout and sea trout.

SEA LICE

SEA WINTER

SMELT

SMOLTS

Young salmon migrating to sea for the first time.

TASK FORCE

An intensive investigation of possible sources of pollution following non-compliance in the catchment.

TURBIDITE

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 } MI/d }	Megalitres per day
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
CBPS	Cornwall Birdwatching and Preservation Society
CBRU	Cornwall Biological Records Unit
CoCo	Countryside Commission
CCC	Cornwall County Council
CLA	Country Landowners Association
CMP	Catchment Management Plan
CNC	Cornwall Nature Conservation
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
FDMF	Flood Defence Management Framework
FE	Forestry 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

ABBREVIATIONS

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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