

EA-South West LEAPs box 5

local environment agency plan

TAMAR ESTUARY AND TRIBUTARIES

CONSULTATION REPORT

JULY 1996



**ENVIRONMENT
AGENCY**

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ENVIRONMENT AGENCY

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Foreword

The Tamar Estuaries and Tributaries Local Environment Agency Plan is the first in a series of such plans to be published by Cornwall Area Environment Agency. These plans expand the concept of former National Rivers Authority's Catchment Management Plans to encompass the wider range of responsibilities of the Agency. This plan sets out the Agency's vision for realising the potential of the local environment and will be used as a principle tool by the Agency at a local and regional level in planning and delivering environmental improvements.

This document is inter-related with the Tamar Estuaries Consultative Forum's Tamar Estuaries Management Plan. The latter concentrates specifically on Plymouth Sound and the estuaries of the Rivers Plym, Tamar, Tavy and Lynher, and is concerned with social, economic and environmental improvements to the estuarine catchment.

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

This document includes relevant information about the catchment and lists the issues we have identified and which we feel need to be addressed. Both plans set out strategic and specific issues and objectives which we consider will enable the effective planning and management of this area into the next century. Please send us your comments, your views are important.

Please send your comment by 23 October 1996 to:

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We look forward to hearing from you.



ROB ROBINSON
AREA MANAGER (CORNWALL)



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INTRODUCTION

Who are We?

The Environment Agency has been formed by bringing together the National Rivers Authority (NRA), Her Majesty's Inspectorate of Pollution (HMIP), the Waste Regulation Authorities (WRAs) and some units of the Department of the Environment (DoE) dealing with the technical aspects of waste and contaminated land.

Our principal aim

Our aim, set out in the Environment Act 1995, is to protect or enhance the environment, taken as a whole, in order to play our part in attaining the objective of sustainable development.

Our objectives

The Environment Agency works towards Sustainable Development through seven objectives, set by Ministers:

- An integrated approach to environmental protection and enhancement, considering the impact of all activities and natural resources;
- Delivery of environmental goals without imposing excessive costs on industry or society as a whole;
- Clear and effective procedures for serving its customers, including the development of single points of contact with the Agency;
- High professional standards, using the best possible information and analytical methods;
- Organisation of its own activities to reflect good environmental and management practice, and provision of value for money for those who pay its charges, and for taxpayers as a whole;
- Provision of clear and readily available advice and information on its work;
- Development of a close and responsive relationship with the public, including Local Authorities, other representatives of local communities and regulated organisations.

MANAGING THE ENVIRONMENT -THE ROLE OF THE ENVIRONMENT AGENCY

What we do

Our work is divided into seven main functions:

Flood Defence has the role of protecting people and the developed environment from flooding by providing effective defences and protection of floodplains. Safeguarding life is our highest priority and to meet this aim we provide a flood forecasting and warning service. Flood Defence also aims to protect and enhance the natural environment by promoting works that are sustainable and work with nature.

The **Water Resource** function comprises the conservation, redistribution and augmentation of surface and groundwater supplies. It includes the powers to encourage water conservation and to promote transfer schemes and to balance the needs of water users and the environment by issuing licences for users to abstract water from rivers and boreholes.

The **Pollution Control** function includes:

- Integrated Pollution Control (IPC); regulating the most polluting, or technologically complex, industrial and other processes in air, on land or in water.
- Water quality and pollution control; which prevents and controls pollution and monitors the quality of rivers, estuaries and coastal waters.
- Radioactive Substances; regulating the disposal of radioactive material, including that from licensed nuclear sites, and regulating the accumulation, keeping and use of radioactive materials, except from

- licensed nuclear sites.
- **Waste Regulation**; setting consistent standards for waste management practice to regulate the treatment, storage, movement and disposal of controlled waste. The Agency also has a requirement to register and monitor those who produce waste imposing obligations to re-use, recover or recycle products and materials.
- Reporting on the extent of contaminated land and contributing to its management (primarily undertaken by local authorities).
- Abandoned mine operators are also required to work with the Agency so that steps can be taken to prevent minewater pollution in the future.

The Environment Agency is responsible for maintaining, improving and developing **Fisheries**. This is carried out by licensing, regulation and enforcement schemes which cover salmon, sea trout, non-migratory trout, coarse and eel fisheries. The Agency also carries out improvements to fisheries by improving the habitat, fish stocks and providing advice to fishery owners.

The **Navigation** function is responsible for managing and improving over 800km of inland waterways, the Harbour of Rye and Dee Estuary. Its aim is to make these resources widely available to the public for water or land based recreational use.

The Agency must also take account of **Recreation** and access. Over 1000 sites in our control are managed for recreational use. We also have a general duty to promote the recreational use of water and land throughout England and Wales.

In fulfilling all its functions the Environment Agency is required to contribute to the **Conservation** of nature, landscape and archaeological heritage. We have a *regard* to conserving and enhancing flora, fauna, geological or physiographical features when carrying out our pollution control functions, and a duty to *further* conservation when carrying out our other functions. We also have a duty generally to promote the conservation of flora and fauna dependent on the aquatic environment.

What we do not do

The Environment Agency does not cover all aspects of environmental legislation and service to the general public. Your Local Authority deals with all noise problems, litter and air pollution arising from vehicles, household areas, small businesses and small industries.

Planning permission is the responsibility of your Local Authority who will contact the Environment Agency when necessary. The Local Authorities also deal with contaminated land issues in liaison with the Environment Agency.

Environmental Health issues should also be directed to your Local Authority - details can be found in your local telephone directory.

Who are our customers?

We have a wide range of customers. Some of them pay us directly for specific services and include:

over 2000 industrial processes, disposal of radioactive waste at 8000 sites; 8000 waste management sites and some 70,000 waste carriers; 100,000 water discharge consents including 6000 sewage works, 50,000 licensed water abstractions, 43,000kms of flood defence works, 1,000,000 angling licences and navigation licences for some 40,000 boats.

Other customers receive services paid for indirectly through Government grants and taxation. These include the public and many businesses and representative groups that form part of our community, such as conservationists and farmers. We also regard government at the local, national and European level as our customers this includes over 500 local authority bodies.

How we are structured

The Agency has a Board of up to 15 members appointed by the Department of the Environment, the Ministry of Agriculture, Fisheries and Food and the Welsh Office and includes the Agency's Chairman and Chief Executive.

The Agency is split into eight Regions covering England and Wales. Each Region has three statutory Regional Committees covering environmental protection, flood defence and fisheries and includes local authority and business representatives. These meetings are open to the public and the media.

Eight Directors provide overall management of the Agency's work and are based at our Head Office in Bristol with supporting offices in London. Regions are split into three or four Areas making a total of 26. Each Region has a Regional General Manager and each Area has an Area Manager.

Our Standards

Environmental standards are set in European and UK legislation. The Environment Agency has the responsibility for enforcing some of these standards within England and Wales.

There is a great deal of legislation that has an impact on the way the Environment Agency operates or the way we carry out our enforcement duties. The main legislation includes the following Acts:

- Salmon and Freshwater Fisheries Act 1975
- Control of Pollution (Amendment) Act 1989
- Environmental Protection Act 1990
 - Part I (Integrated Pollution Control)
 - Part II (Waste)
- Water Resources Act 1991
- Land Drainage Act 1991
- Water Industry Act 1991
- Radioactive Substances Act 1993
- Deregulation and Contracting Out Act 1994
- Welsh Language Act 1995
- Environment Act 1995

We are also the competent Authority for over 25 European Community environmental directives whilst a further 70 directives affect our policies and activities. For example, these include:

Quality of Bathing Waters, Dangerous Substances, Industrial Plant Emissions, Waste Management Framework, Packaging & Packing Waste, Quality of Water to Protect Freshwater Fisheries and the Urban Waste Water Treatment.

Details of all new legislation, byelaws and statutory instruments affecting the Environment Agency are given in our Annual Report and Accounts.

We also operate non statutory standards such as our informal river quality objectives that are aimed at particular stretches of river and estuary, you will find details about these in this plan.

Operational Standards cover our technical, scientific and engineering procedures which are necessary to put European and UK legislation and Environment Agency policy into practice.

These standards take many forms, including policy statements, procedural manuals and a suite of quantitative output and performance measures that we monitor quarterly and some annually. Details of our operational standards are published in technical handbooks, research and development reports and information leaflets. Further details are available from the Environment Agency.

THIS LOCAL ENVIRONMENT AGENCY PLAN

The Consultation Report

This Local Environment Agency Plan Consultation Report gives you the opportunity to comment on environmental problems or the work of the Agency, it:

- ☐ describes the environmental resources of the area
- ☐ explains how these resources are affected by human uses or pressures
- ☐ outlines issues where the Environment Agency or others need to take action to address problems in the environment.

The Consultation Report includes the following sections:

The Area and its Natural Characteristics

This chapter provides a brief and general introduction to the area describing its key environmental resources.

Catchment Uses

We place ever more demands on the environment but expect it to be protected from harm. This section looks at the main pressures that we put on the environment.

State of the Environment

In this section we look at different environmental media such as air, water and land and consider what standards are available to allow us to assess the state of the environment within and between these media.

Issues and Options for Action

Throughout this report we raise issues. These issues and options for action are summarised in this section.

The Action Plan

We will collate responses to this Report and publish an Action Plan in February 1997. Each year we will review the progress that has been made with the actions identified in the Action Plan and publish a brief review. Within five years of publishing the Action Plan we will do a major review of the progress we have made.

Local Environment Agency Plans (LEAPs) and Development Plans

While we can control some of the things which influence the quality of the water environment we have only limited 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 advise and guide 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.

Local Environment Agency Plans and Catchment Management Plans

This LEAP slots into a sequence of plans which were being prepared by the NRA to cover all river catchments in England and Wales by the end of 1998. Local Environment Agency Plans will be used by the Agency to cover the same topics as Catchment Management Plans but they will also deal with new topics to cover the full range of the Agency's responsibilities.

This Plan and the Tamar Estuaries Management Plan

This LEAP was produced alongside the Tamar Estuaries Management Plan. Both are non statutory plans which cover part of the same area. The need to produce two plans arises from differing organisational requirements. This Environment Agency Plan concentrates particularly on the environmental aspects of the area drained by a number of principal rivers. The Tamar Estuaries Management Plan concentrates particularly on the Plymouth Sound and estuaries and is concerned with social, economic and environmental improvements.

Both are inter-related, and to avoid excessive duplication each document raises subjects most appropriate for that document, with appropriate cross referencing. Both will require the joint action of a number of bodies to deliver suggested actions to bring about improvements.

GLOSSARY

ABSTRACTION

Removal of water from a surface or groundwater source of supply.

ADIT

Gently sloping passage from mine workings into valley areas to allow water to drain out of the working (the downstream entrance is called the adit portal).

ALLUVIAL DEPOSITS

Sedimentary deposits resulting from the erosive action of rivers. Typically fine grained material carried by the river and deposited in areas such as floodplains, but often including sandy or gravelly beds too.

ANNEX 1A SUBSTANCE

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

AQUIFER

Layer of porous rock able to hold and transmit water. Often classified as major, or minor, depending on the extent to which they support higher yielding borehole systems.

AUGMENTATION

The support of a downstream river abstraction by releasing (usually) equivalent quantities of water from an upstream source (whether it be a reservoir, another river or groundwater source such as a borehole).

BASEFLOW

The flow in a river comprising emergent groundwater sources. In dry conditions river flows comprise entirely of baseflow.

BIOACCUMULATION

Concentration of pollutant substances, such as metals, within the tissues of organisms.

BIOCHEMICAL OXYGEN DEMAND (BOD)

A measure of the amount of oxygen consumed in water, usually as a result of organic pollution.

BRYOPHYTES

Mosses and liverworts.

BUFFER ZONE

Strip of land 10-100m wide, alongside rivers which is removed from intensive agricultural use and managed to provide appropriate habitat types. Benefits include potential reduction of inputs into the river such as silt, nutrients, livestock waste, as well as improving habitat diversity and landscape.

CAMBIC STAGNOGLEY SOILS

Soils with a distinct topsoil and no clay-enriched sub-soil.

CHERT

A hard sedimentary rock very similar to flint.

COMPENSATION FLOW

A defined release from a reservoir to compensate for the impact of the impoundment by maintaining a minimum flow in the river downstream.

CONJUNCTIVE USE

The operation of two or more sources in a systematic manner to provide a yield greater than the sum of those sources if operated independently.

GLOSSARY

CONSENT

A statutory document issued by Environment Agency under Schedule 10 of Water Resources Act 1991 to indicate any limits and conditions on the discharge of an effluent to 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-base assessment to determine the susceptibility of surface waters.

CULVERT

Channel or conduit carrying water across or under a road, canal etc.

CYPRINID

Fish of the carp family (i.e. coarse fish).

DEPURATE

To make or become free of impurities.

DESORPTION

The removal of absorbed material.

DETERMINAND

That which is to be determined or measured.

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 Environment Agency 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 and Sch 22 S139 of the Environment Act 1995. Drought Orders are sub-divided into 'Ordinary' and 'Emergency' Drought Orders. A Drought Order could contain provisions such as; to authorise abstraction from an unlicensed source, override the conditions on an existing abstraction licence, limit the amount of water which may be taken from a source, vary discharge conditions or might allow the prohibition of use of water for particular purposes, to allow a ban on non-essential use of water (for example in car washes) or to introduce the use of stand-pipes.

DROUGHT RELIABLE YIELD

The output capacity of a reservoir, reservoir system, conjunctive use scheme etc. It is the average output (volume/day) that can be sustained through a design drought period. 1976 has been regarded as the critical historical drought sequence, with a risk of occurrence regionally of approximately 1:50 years but current research into extended flow sequences back to the last century and modelling particular water supply schemes suggests that 1975-76 may be much more severe than a 1:50 years sequence.

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.

GLOSSARY

ENVIRONMENTALLY SENSITIVE AREA

Area where the landscape, wildlife and historic interest are of national importance. Payments are made by Agriculture and Fisheries Departments for appropriate sensitive land management.

ESCAPEMENT

Numbers of fish that survive to spawn.

EVAPOTRANSPIRATION

Loss of water by land plants due to evaporation and transpiration.

EUTROPHICATION

The enrichment of water by nutrients, especially nitrogen and/or phosphorous, which causes: 1) accelerated growth of algae and higher plant, 2) changes in the ecological balance, and 3) deterioration in water quality.

FAULT

Plane surface of fracture in rock body, along which observable relative displacement has occurred between adjacent blocks.

FISSURE

A crack or open break in rocks.

FISH SURVEY

Electric-fishing survey of between 1 and 3 runs within a stop-netted section of river.

FLUVIAL

Pertaining to river flow and its erosive activity.

FRY

Juvenile salmonids that have left the gravel and are less than one year old.

GLEYSOILS

One of the seven major groups in the soil classification of England and Wales. They are characteristically affected by the periodic or permanent saturation by water in the absence of effective artificial drainage.

GRILSE

Atlantic salmon that have remained in the sea for only one winter.

GROUND TRUTHING

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

HYDROGEOLOGY

Branch of geology concerned with water within rock bodies or bedrock.

LEACHATE

Solution formed when water percolates through a permeable medium. Can be mineral-rich, toxic or even carry bacteria.

LICENCE OF ENTITLEMENT

Licence granted under Schedule 26 of the Water Act 1989 in respect of a previously exempt abstraction greater than 20m³/day which required a licence by virtue of an amendment to Section 24(2) and (3) of the Water Resources Act 1963. (This only covered particular domestic and agricultural uses, including fish farming and flows to domestic amenity ponds).

GLOSSARY

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 e.g. mayfly, 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 Environment Agency in Regional Offices. The Environment Agency has the power to carry out works to improve drainage or protect land and property against flooding on watercourses designated as 'Main River'. The Environment Agency 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, e.g. granite, where the country rock has been altered and affected by the heat.

MINIMUM ACCEPTABLE FLOW (MAF)

A prescribed flow in river set by the Secretary of State under Section 21 of the Water Resources Act 1991 as amended by Sch 22 S133 of the Environment Act 1995, 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).

MULTISEA WINTER

Atlantic salmon that have remained in the sea for two winters or more.

NATURAL AREA

The whole of England has been described as a series of ecologically distinct areas following survey work by English Nature.

ORDINARY WATERCOURSE

A flood defence term, not relevant to other functions. A watercourse that does not form part of a main river.

PARR

Juvenile salmonids aged one year and older.

PERMEABILITY

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

PHABSIM

A suite of computer programs used to generate habitat *versus* discharge relationships for assessing the effects of abstraction upon fish, invertebrates and macrophytes.

PREVIOUS SPAWNER

Salmonids that are returning to spawn for a second or subsequent occasion.

PODZOLIC SOILS

Well drained black or dark brown soils, with a compact subsurface horizon enriched in humus and normally overlain by a bleached layer.

GLOSSARY

POROSITY

The volume of water which can be held within a rock or soil, expressed as the ratio of the volume of the void space to the total volume of the material.

POTABLE

Water of a quality suitable for drinking.

PRESCRIBED FLOW (pf)

Flow below which a river must not be reduced as a result of licensed abstraction.

PRESCRIBED FLOW CONDITION

A prescribed flow condition is a trigger for abstraction to be reduced or cease unless supported by artificial releases. Often a specific condition on abstraction licenses to protect the river environment and other legal users.

Q95

The flow that on average is equalled or exceeded for 95% of the time.

REDD

Hollow created in river bed gravels by spawning salmonid fish into which the female deposits ova.

RESERVOIR PUMPED STORAGE.

The supplementation of the natural inflow to a reservoir with river water abstracted downstream or transferred between catchments, and pumped to the reservoir at times of high flow. Pumped storage ensures that the reservoir is refilled sufficiently for the start of the next Summer drawdown period.

RIFFLE

Stony or gravelly part of river bed shallow in dry weather flow. Fast stream on most non-chalk areas have alternating riffles and pools.

RIFFLE SURVEY

Electric-fishing survey on riffle areas for 20 minutes with no stop nets.

RIPARIAN OWNER

Owner of riverbank and/or land adjacent to a river. Normally owns riverbed and rights to at least midline of channel.

RIPARIAN ZONE

Zone alongside watercourse stretching from top of channel to next change in land form (most often banks) or vegetation type.

RIVER CORRIDOR

Land which has visual, physical or ecological links to a watercourse and which is dependent on the quality or level of the water within the channel.

RIVER QUALITY OBJECTIVE (RQO)

The level of water quality that a river should achieve in order to be suitable for its agreed uses.

RIVER REGULATION

The maintenance of a stated flow in rivers in order to allow abstraction to continue during times of low flow and for environmental protection. This is achieved as for river augmentation by supporting river flows using upstream sources.

SALMONID

Game fish of the salmon family e.g. salmon, brown trout and sea trout.

GLOSSARY

SEA LICE

Parasite found on salmon who have recently returned to freshwater. Cannot survive long in freshwater.

SMOLTS

Young salmonids migrating to sea for the first time and adapted to life in salt water.

STAGNOGLEY SOILS

Seasonally waterlogged, slowly permeable soils, prominently mottled with a distinct topsoil.

TASK FORCE

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

TRANSMISSION LOSSES

Transmission losses comprise 'river losses' and 'operational augmentation losses'. River losses relate to identified losses through the bed or banks and estimates of surface water evaporation. Operational augmentation losses can be from errors in forecasting (when augmentation releases need to start and end), resulting in augmentation releases on days they are not required or when demand is lower than forecasted and water is released in excess of abstraction needs.

TWO SEA WINTER (2SW)

Atlantic salmon that have remained in the sea for two complete and consecutive winters.

1.0 CATCHMENT VISION

The catchment is one of heavy contrasts. Plymouth, the largest urban area in Devon and Cornwall is surrounded by landscape of the highest quality and bordered by the sea. The city and its hinterland have a long maritime history, and naval and defence industries continue to be important to the local economy. Historic mining and industrial activity has significantly affected land, water quality and estuary sediments over many years. Current practices have been reviewed with a greater consideration given to environmental impacts, however, the legacy remains. Throughout the catchment there is an important and diverse agricultural and horticultural base.

A large population puts pressure on all infrastructure and services, including water supply, sewage treatment and waste management. Although much public water supply is imported, the catchment contains Burrator reservoir, and river abstractions which have come under demand pressure. Demand and resource management are clearly important. Water from the River Tavy is used for hydro-electric power generation and the cumulative effects of water abstraction, particularly on this river, are of concern in the catchment.

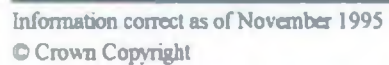
Plymouth, Plympton and other towns have suffered from serious flooding, resulting in the building of a number of Flood Alleviation Schemes. It is seen as vitally important that new development does not compromise the protection given by these systems or introduce new problems. The future management of flooding in the catchment must be addressed, including a review of managed retreat on the Tamar and coastal defences.

Despite development pressures of the urban areas there are numerous landscape, conservation and archaeological designations and proposed designations, of international, national and county importance. The catchment also contains a variety of important plant, animal and bird species. Dartmoor National Park, the Tamar Estuary and the coastal fringe provide extensive recreational opportunities.

In order to meet the diverse human demands, whilst protecting the outstanding natural resources upon which a healthy environment and lifestyle depends we see key objectives to include:

- * Maintenance of high water quality standards with improvements on some sections of water. Further reductions in pollution incidents and risk, particularly in the china clay and agricultural industries.
- * Ensuring the efficient and prudent use of abstracted water in order to protect the environment and reduce the need for development of additional sources.
- * Review of unacceptably low flows due to authorised abstractions, not drought related.
- * Minimizing the risk to people and property from flooding.
- * Preventing adverse environmental impact from areas of mineral working and contaminated land, including the progressive move to river needs consents for areas of continuing mining.
- * Maintain, improve and develop fisheries to their natural carrying capacity.
- * To increase enjoyment and appreciation of the water environment.
- * Maintenance of the natural hydrological cycle, including natural river and wetland functions and processes.
- * Maintenance, and where appropriate, enhancement of the biodiversity of aquatic and wetland habitats and species and those associated with them. Features of key importance within the proposed Special Area of Conservation and Special Protection Area may require particular consideration.

2



2.0 SCOPE OF THE PLAN

This plan deals with the land drained by the River Yealm and Estuary and the rivers which discharge into the Tamar Estuary, **except** the River Tamar. The River Tamar down to the Normal Tidal Limit at Gunnislake Weir has already been reviewed in the 'Freshwater Tamar and Tributaries Consultation Report' (Ref 1) and an Action Plan produced (Ref 2).

For the purposes of this Consultation Report the volume and quality of water flowing in the River Tamar is only considered downstream of Gunnislake Weir, and for its effect on uses and activities within the estuary.

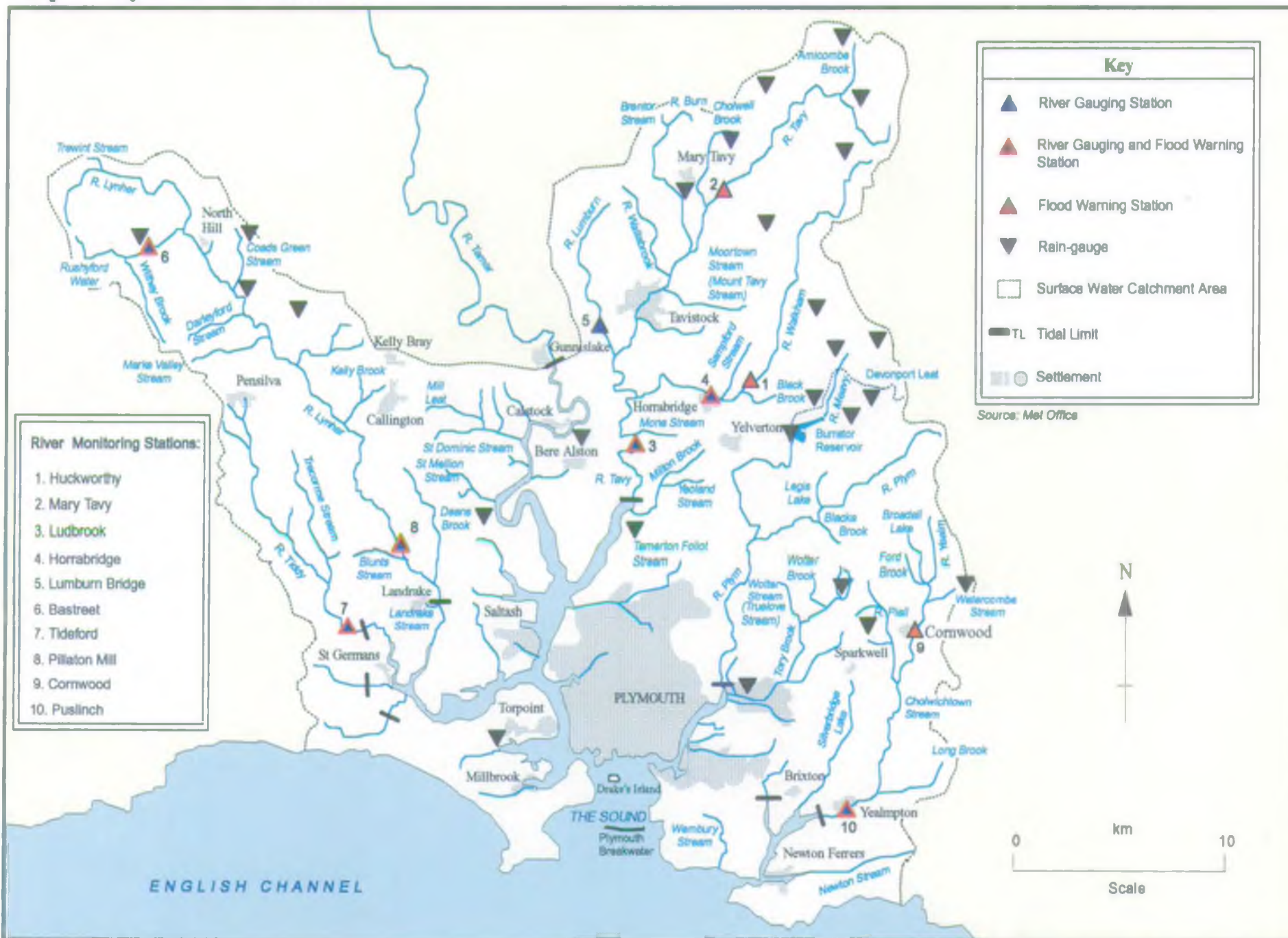
2.1 CATCHMENT STATISTICS

Area Drained:	821.75 km ²	
Approximate Population: (from 1991 Census)	Plymouth	243,350
	Rest of catchment	85,900
Length of Main River:	138.7 km	
Length of Controlled Water:	286.6 km	
Average Annual Rainfall: Long Term Average (1961-90)	1450 mm	
Principal Towns:	Plymouth Tavistock Saltash	
Local Authorities:	Caradon District Council North Cornwall District Council Plymouth City Council South Hams District Council West Devon Borough Council Dartmoor National Park	

Table 1: Drainage Areas

River	Area drained upstream of:	Area drained (km ²)	Length of river
Tamar Estuary		71.75	NIL
Tavy	Tidal limit	235.50	35.2
Plym	Tidal limit	151.50	21.3
Yealm	Tidal limit	117.75	18.5
Lynher	Tidal limit	245.25	34.8

Map 2 - Hydrometric Network



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The Environment Agency hydrometric network is shown on Map 2. The seven river gauging stations take river level/flow measurements every 15 minutes. Average flows, catchment areas and length of records at the gauging stations are shown in Table 2. In addition to the gauging stations, data exists from spot measurements taken at locations throughout the catchment. A network of 26 rain-gauges provide good coverage of the catchment (see Map 2). Annual rainfall totals at rain-gauge sites vary from 1026 mm to 2163 mm (1961-90 LTA) within the catchment. There are no groundwater monitoring sites within the catchment.

Table 2: Hydrometric gauging stations

Station	River	NGR	Start Date	Catchment Area (km ²)	Gauged Average Daily Flow (cumecs)
Bastreet	Withey Brook	SX244764	09/12/72	16.2	0.593
Horrabridge	Walkham	SX513699	18/04/74	44.6	1.774
Ludbrook	Tavy	SX476681	16/11/81	197.3	6.337
Lumburn Bridge	Lumburn	SX459732	25/02/76	20.5	0.503
Pillaton Mill	Lynher	SX368625	10/05/61	135.5	4.317
Puslinch	Yealm	SX574511	12/05/62	54.9	1.595
Tideford	Tiddy	SX344596	01/10/69	37.2	0.897

Map 3 - Geology



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CATCHMENT CHARACTERISTICS

3.0 CATCHMENT CHARACTERISTICS

3.1 Introduction

Five rivers run into the Tamar estuary, the Tamar, Tavy, Plym, Lynher and Tiddy. The Tavy and Plym rise on the Dartmoor granite, the Lynher on Bodmin Moor and the Tiddy on the foothills of Bodmin Moor. The River Yealm rises at Yealm Head on Dartmoor and flows south to Yealmpton where the main channel turns and flows south westward to run into the Yealm estuary, east of Plymouth Sound.

Plymouth, a major maritime and industrial city, contrasts strongly with the rural character of the upper catchments, and the moorland area of the headwaters.

Population

The population of the catchment is approximately 329,250 (1991 census), of which 243,350 live in Plymouth. Although growth in the population of Devon and Cornwall is not expected to continue at the same high rates as in the 1970s and 80s, increase in population will put pressure on services and infrastructure such as water supply, sewage and waste disposal. Pressures on South East Cornwall and the rural parts of Plymouth's travel to work area will continue particularly as additional land for housing and employment in the City itself is diminishing.

Geology and Mineralisation

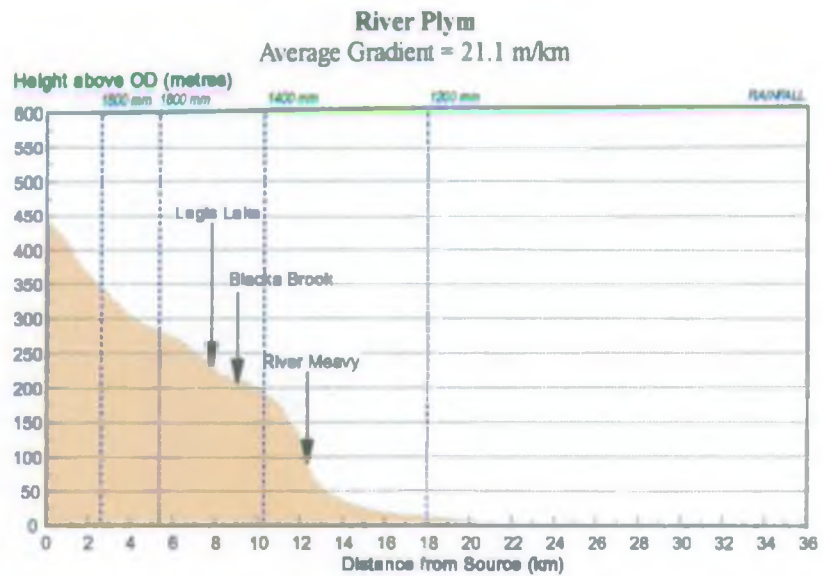
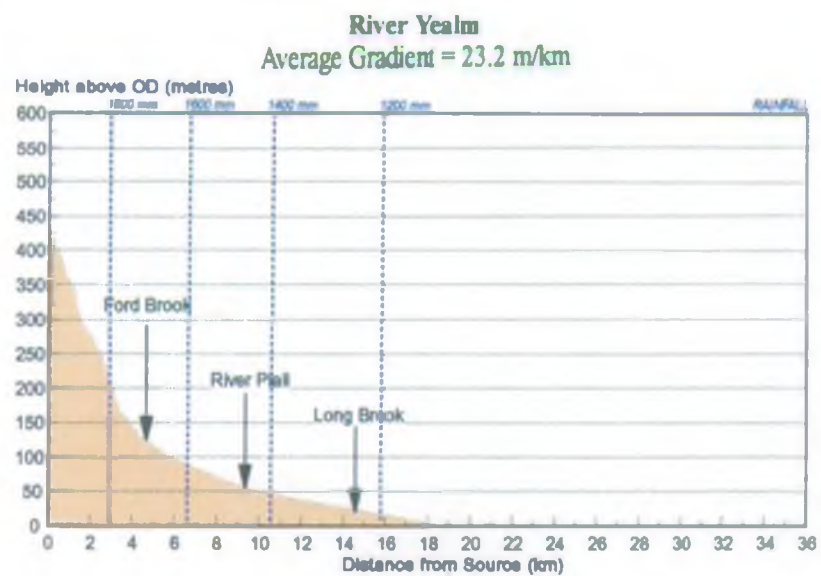
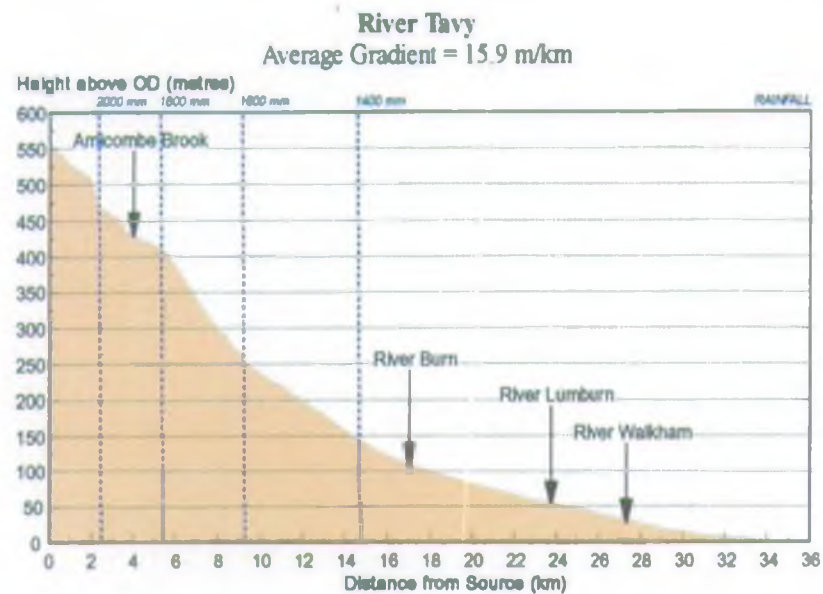
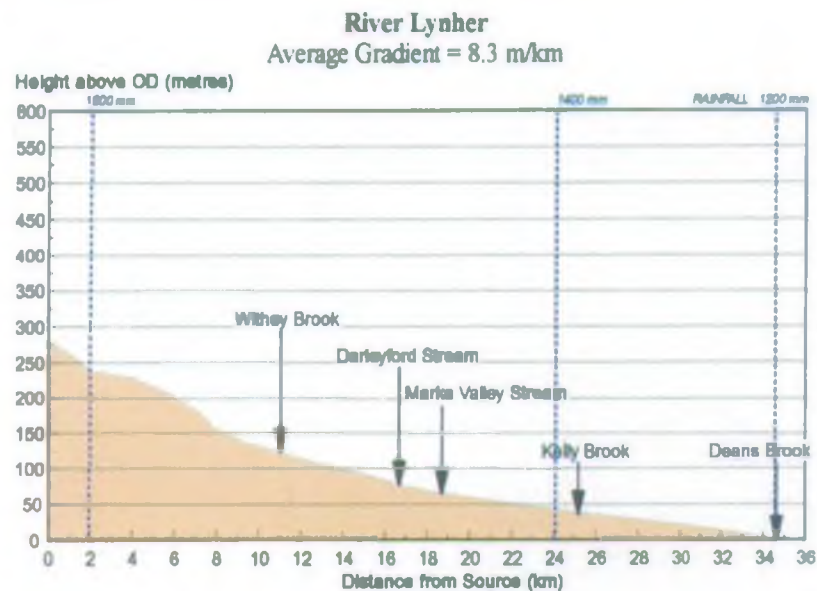
During the Lower and Middle Devonian and the Upper Carboniferous Periods nearly 400 million years ago, sediments were laid down in various different environments in the area that was to become the Tamar Catchment. These sediments are now seen as the slates, limestones and grits that underlie most of the catchment. A major mountain building event during the Carboniferous Period intensely folded the strata which resulted in extensive fissuring and faulting. This event was largely completed before the granitic masses of Bodmin Moor and Dartmoor were intruded some 300 million years ago. These granitic masses touch the north-western and eastern catchment boundaries respectively. The heat of these intruding magmatic bodies thermally altered the rocks on their margins, creating a metamorphic aureole with associated tin/copper/arsenic and, locally, tungsten mineralisation.

The geology of the catchment impacts on the water environment in a number of ways including landforms, soils, groundwater storage, surface water flow patterns and the natural chemical composition of the water. The exploitation of the mineralised areas has also left its own legacy.

Hydrogeology

The rocks that make up the catchment have low primary permeability and porosity which limits groundwater flow and storage. However, the widespread folding and faulting that the rocks have undergone have resulted in fractures and fissures. This secondary permeability and porosity has allowed for the storage and movement of some groundwater, particularly within the limestones to the east of Plymouth. Groundwater storage and permeability have been enhanced near the surface as a result of weathering and other processes but, overall, storage remains low and flows are generally restricted to shallower depths. Groundwater levels within the catchment generally reflect the local topography and drainage pathways. Alluvial deposits along river valley floodplains provide additional groundwater resources.

Figure 1 - River Profiles



CATCHMENT CHARACTERISTICS

Where mining has occurred, local groundwater storage can be significantly altered. The associated mine drainage systems can cause significant flows over large distances and, in some cases, into adjacent catchments. Poor mining records means that the course of many such pathways cannot be determined with any certainty.

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

Hydrology

An example of the hydrology of a river in the catchment is given below for the River Tavy.

The River Tavy rises on the western slopes of Dartmoor National Park and flows south west, before joining the Tamar Estuary north of Plymouth. The Tavy has a reputation as being one of England's fastest flowing rivers. Over the 28 kilometres from the source on Dartmoor to the tidal limit at Lopwell it drops over 560 metres at an average gradient of 15.9m/km. (See Figure I, River Profiles).

The typical variation in flow over the year at Ludbrook gauging station is shown in Figure II. Like most rivers in the region the highest flows are generally recorded in January and December when the water table is near the ground surface. The small groundwater store and slowly permeable soils in the upper catchment promote rapid surface runoff and floods are characterised by a rapid rise and fall in water level.

Lowest flows are usually recorded in June, July and August when the water table is further from the ground surface. Whilst the natural characteristics of the catchment including, geology, soils and slope have an important influence upon the flow regime, human activities, particularly through harnessing the river for water power are also significant.

In the Eighteenth and Nineteenth centuries water was diverted from the river to generate power for processing ore and to pump water from the many mines in the catchment. The pumping capacity required and hence the amounts of water needed varied greatly depending on the local aquifer properties of the generally hard low-permeability strata. There are probably still several mine adit discharges, some of which may be contributing to low flows.

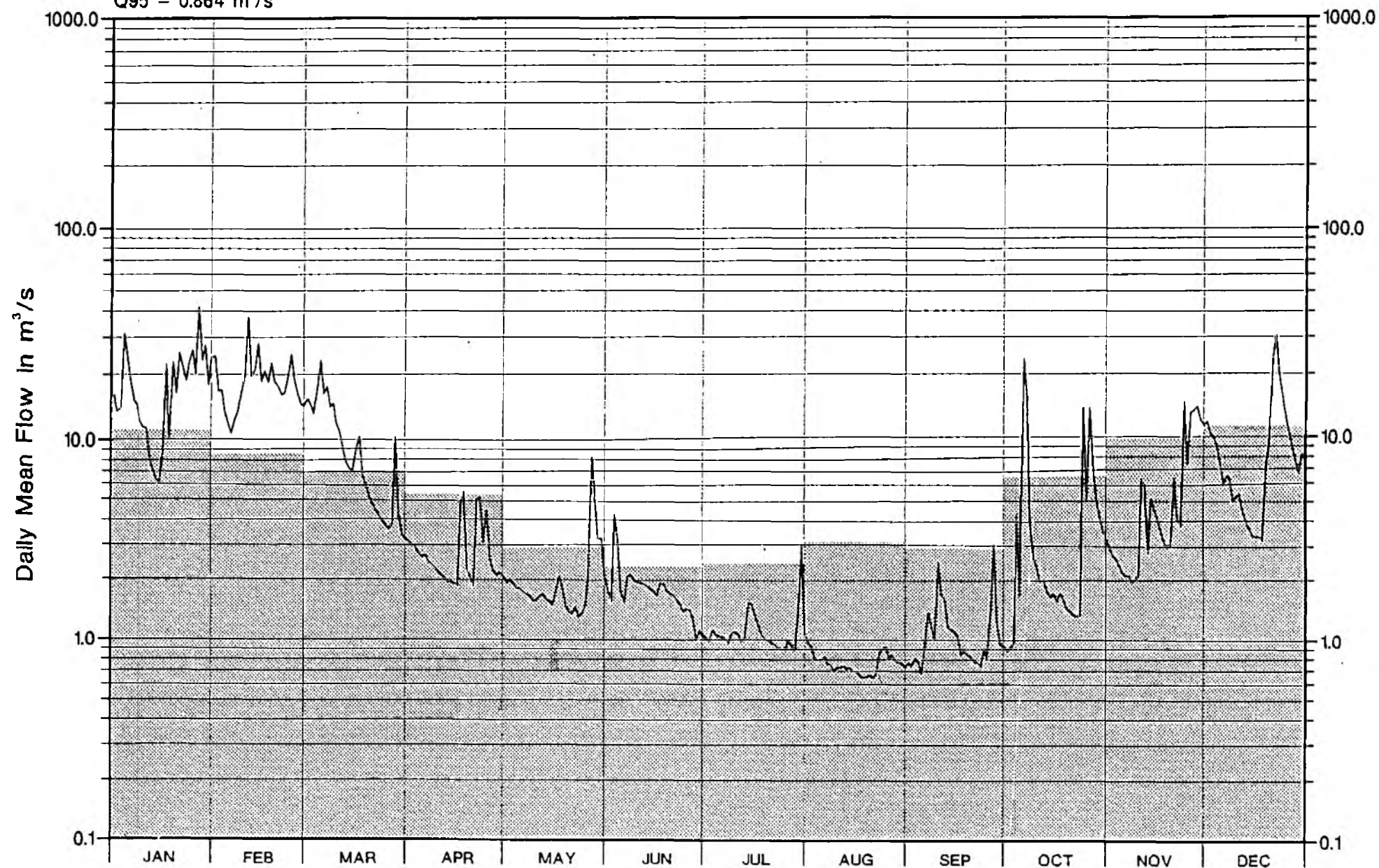
Whilst most of these diversions fell into disuse in the late Nineteenth and early Twentieth century the leats at Tavy Cleave and Hillbridge were refurbished in the 1930s to provide water for a new power station at Mary Tavy. The station is still generating hydropower today and its operation has a significant impact on the flow regime of the River Tavy (see Sections 4.11, page 70 and 5.2, page 119).

The Tavistock-Morwellham Canal was built at the start of the Nineteenth Century to transport coal landed at Morwellham to Tavistock and wool, minerals and agricultural produce in the opposite direction. In 1933 a small reservoir and power station was built at Morwellham in the Tamar valley. Today water is still abstracted at Abbey Weir in Tavistock and transferred to the power station before being released to the River Tamar downstream of the tidal limit. The abstraction therefore represents a total loss to the River Tavy and the measured flow at Ludbrook gauging station (1982-94) is significantly less than the naturalised flow, see Table 3.

Figure II Hydrograph of the River Tavy at Ludbrook, 1995

ADF = 6.321 m³/s

Q95 = 0.864 m³/s



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Table 3: Flows at Ludbrook, River Tavy

	Mean Flow (m³/sec)	Q95 (m³/sec)
Measured flow Ludbrook gauging station (1982-94)	6.338	0.889
Naturalised flow Ludbrook gauging station (1982-94)	7.224	1.114
Reduction in flow	12%	20%

Note: Naturalised flow record: The flow that would have occurred with no artificial abstractions or discharges.

The flow to the estuary is further reduced by SWW public water supply abstraction at Lopwell when flow to the river is above the prescribed flow condition on the Lopwell licence. The net loss to the river, however, is the difference between the abstraction at Lopwell and the water is returned to the river as effluent via Crowndale STW.

Landscape, Wildlife and Archaeology

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

Landscape

This catchment displays a diverse range of landscapes. About a third of the area lies within the upland of Dartmoor, and has a culturally and ecologically rich landscape of heaths and moors, bogs, pools, granite tors, and archaeological features such as stone circles, burial sites and clapper bridges.

This high ground drains into the Tamar Valley, which is characterised by deep, well wooded ravines, with extensive creeks and mudflats in the lower reaches. Man's legacy is evident in the many mining remains and abandoned market gardens on the valley slopes.

Flanking Plymouth Sound, the South Hams and Caradon consist of rolling hills supporting relatively intensive agriculture. These hills are dissected by rias (drowned river valleys) and culminate in rocky headlands and coves along the coast.

The urban centre of Plymouth, which is the largest settlement west of Bristol, occupies the central lowlands of the catchment. It has a distinctive maritime flavour along the waterfront, much of which is bound-up with England's naval and seafaring history.

The different landscape types of England have been defined by the Countryside Commission, who have generated 'The New Map of England'. This provides more information on most of the landscapes described above. This is to be superseded by a new Joint Map, produced with English Nature, which will complement other initiatives such as the Natural Areas programme.

CATCHMENT CHARACTERISTICS

Wildlife Habitats

The important wildlife feature of this catchment is the range of estuarine habitats found within the rias. Mudflats occupy a significant amount of the channel in the lower reaches of all the major rivers draining this catchment. Estuarine mud is an extremely productive ecosystem as it contains nutrient-rich silts from the higher reaches of the river. Invertebrates are prolific in the mud, and attract flocks of feeding wading birds and waterfowl that reach nationally and internationally significant numbers. Estuaries are restricted, threatened habitats and are recognised as a priority under the European Union Species and Habitats Directive.

Other wetland habitats such as reedbeds and freshwater marshes are significant in certain river valley areas, while substantial stands of deciduous woodland fringe many reaches of river in the catchment. These sheltered valleys hold an important proportion of the woodland within Devon and Cornwall, two counties which are windswept and relatively treeless. Many specialised plants and animals live here, in particular within woods bisected by a fast-flowing, rocky watercourse.

The high moors at either side of the catchment support habitats such as blanket bog, acid grassland, dry and wet heathland and scattered scrub. These two areas of moorland constitute virtually all the upland in southern Britain, and support scarce plant, animal and bird populations more commonly found in Wales and the north of England.

Historic Environment

Two important historic aspects of this catchment are the rich Bronze Age and Iron Age remains on Dartmoor and Bodmin Moor and the various historic sites in and around Plymouth, which illustrate its development as a Naval port of high strategic importance. The Medieval tin industry has left remains, particularly in river valleys where tin streaming took place.

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 County Council Environment Department have an ongoing programme (the Sites and Monuments Record) to catalogue such sites. The Environment Agency will liaise closely with such groups and archaeologists in Dartmoor National Park Authority and Plymouth City Council.

Notwithstanding the importance of protecting the historic environment for its own sake, a wealth of documented information exists on such things as mining tips, domestic dumps and former smelting sites. This can provide essential knowledge on likely or possible pollution sources in the present day, and should be more fully utilised.

4.0 CATCHMENT USES

In the following section on catchment uses, we start each 'use' with boxed text which specifically sets out the objectives and role of the Environment Agency with respect to that use.

4.1 Conservation - Landscape, Wildlife and Archaeology

Here we consider the natural environment and the historic built environment. We concentrate in particular on rivers and wetlands.

Our Objectives

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

The Role of the Environment Agency

In fulfilling all our functions we must contribute to the conservation of nature, landscape and archaeological heritage. We have a *regard* to conserving and enhancing flora, fauna, geological or physiographical features when carrying out our pollution control functions, and a **duty** to *further* conservation when carrying out our other functions. We also have a **duty** generally to *promote* the conservation of flora and fauna dependent on the aquatic environment. An **important** part of our work is to influence land use planners and land managers to look after rivers and wetlands sensitively. Legislation tells us what we can and can't do to regulate work in rivers and floodplains.

Our work involves a range of activities:

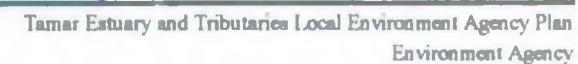
- * we manage our own work and control the work of others to ensure that landscape, wildlife and archaeology are protected
- * we study river and wetland wildlife and we are developing better **methods** for doing this
- * we are developing standard ways of reviewing the effects of our work on wildlife
- * 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

Designated Areas

National Park - Part of Dartmoor National Park covers the east of this Plan area. National Parks are afforded special protection from development, overseen by National Park Authorities. Their broad objectives are to conserve and enhance the natural beauty of the landscape, to promote its enjoyment by the public and take account of the needs of the local community.

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CATCHMENT USES

Areas of Outstanding Natural Beauty (AONB) - The Tamar Valley AONB and Cornwall (Rame Head) AONB are within the catchment. Parts of the Cornwall AONB (Bodmin Moor) and South Hams AONB cover the north west and south east corners of the catchment. AONBs are landscapes of national significance, and are afforded special protection from development by Planning Authorities.

Special Areas of Great Landscape Value (SAGLV) and Areas of Great Landscape Value (AGLV) - These are County designations affording the areas protection in the County Structure Plan. SAGLVs are considered equivalent to AONBs. Kit Hill SAGLV straddles the catchment boundary. The Lynher Valley and South East Caradon are designated AGLVs. In its local plan Caradon District Council has proposed Trebeigh Woods to Pensilva as an AGLV.

Heritage Coast - This is a national designation applied to coastlines which contain the finest stretches of undeveloped coast, with rich landscape, conservation and recreational heritage and value. Heritage Coast Plans in these areas seek to develop co-ordinated protection and use. Within the catchment is the Rame Head and part of the South Devon coast Heritage Coast. The latter is also designated a Coastal Protection Area in the Devon Structure Plan.

Both rural and built up river valleys are important parts of the valued landscapes of the catchment.

4.1.2 Wildlife

Designated Areas

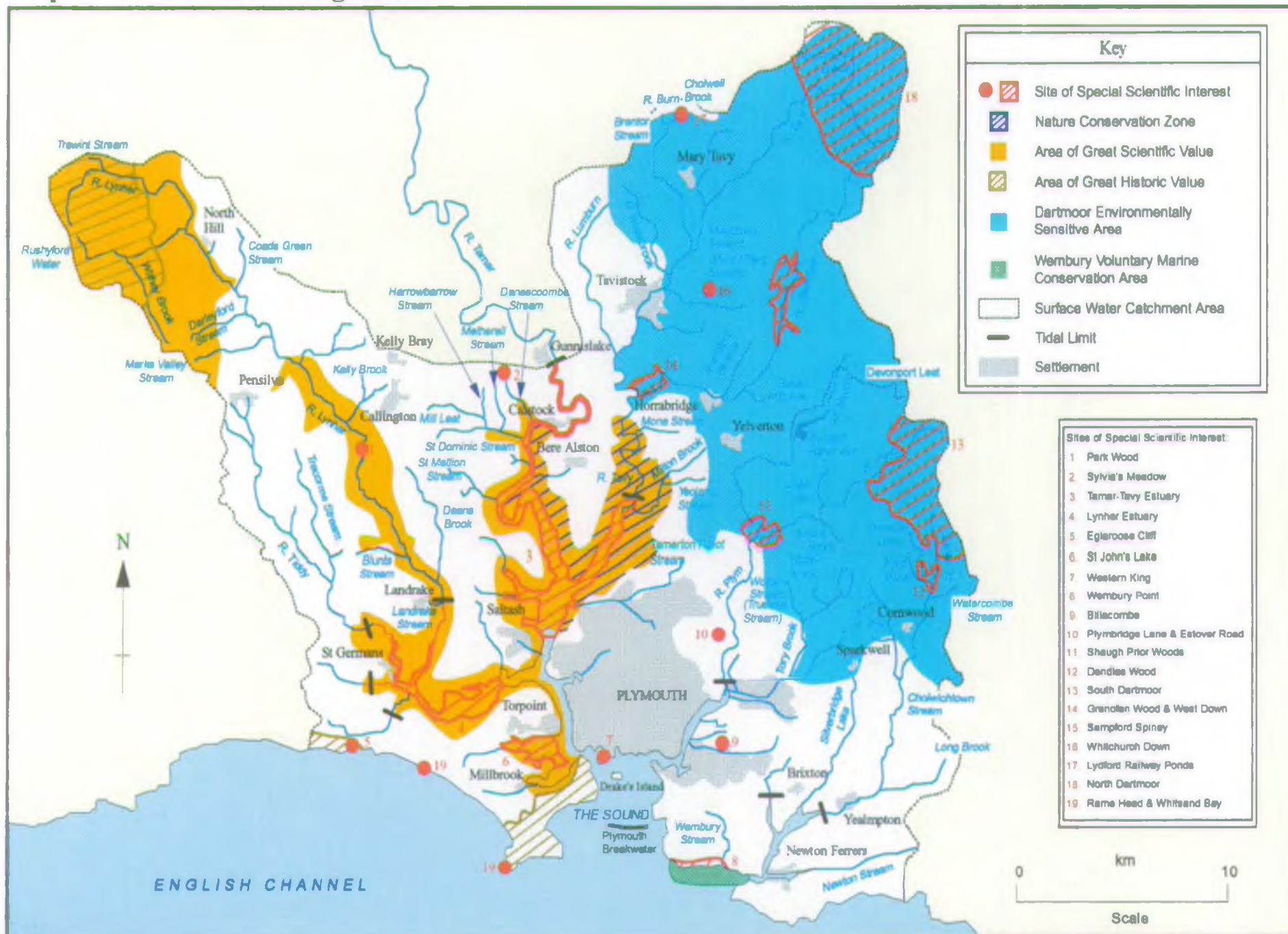
Proposed Special Areas of Conservation (SACs) - SACs are currently being proposed across the European Union (EU) member states to protect the habitats and species of prime conservation importance within the EU. Two candidate sites have been put forward in this catchment: Plymouth Sound and Estuaries, which is an important intertidal area and North Dartmoor, which contains blanket bog. For further information contact English Nature, the Government advisor on wildlife conservation.

Proposed Special Protection Area (SPA) - SPAs are proposed by English Nature under the EU Birds Directive. They are sites of international importance for various bird species. One site is proposed within the muds of the intertidal part of the catchment, incorporating several existing SSSIs (see below). For further information contact English Nature.

Sites of Special Scientific Interest (SSSI) - SSSIs are recognized as nationally important sites, and are afforded specific protection through legislation. Within the catchment there are 32 SSSIs (see Appendix A). Three of these are large intertidal sites, two are moorland bogs and five are steep, wooded valleys. The water environment is particularly important to these sites. Fifteen sites have been designated for geological reasons - an indication of the area's complex geology and rich mining legacy.

Dartmoor Environmentally Sensitive Area (ESA) - This ESA, designated in 1995, overlaps in part with Dartmoor National Park, but also extends outside the Park in places. ESAs seek to maintain areas of high landscape and nature conservation value through payments to landowners for carrying out traditional or 'environmentally friendly' farming methods.

Map 5 - Conservation Designations



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Areas of Great Scientific Value (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 3)) buffer zones around sites, wildlife corridors to link sites, and emphasize the most important areas of nature conservation to concentrate resources.

Nature Conservation Zone (NCZ) - This designation, like AGSVs, seeks to provide buffer zones around sites, wildlife corridors to link sites, and emphasize the most important areas for nature conservation to concentrate resources

Cornwall Nature Conservation Sites (CNC Sites) - there are 46 CNC sites within the catchment. CNC sites are notified by 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. For a more detailed description of the nature and location of the sites in the catchment contact CWT.

County Wildlife Sites (CWS) - Devon Wildlife Trust will complete designations similar to CNC sites in the Devon part of the catchment in 1996. In the meantime liaison takes place between the Environment Agency and DWT on any sites believed to have particularly sensitive or valuable habitats or species. As county sites become defined, we will utilise and promote them wherever appropriate.

Local Nature Reserves/Site Locally Important for Nature Conservation (SLINC) - Around 50 of these sites are defined within the City of Plymouth and appear on the Local Plan (Ref 4) which contains policies that ensures development is sensitive to conservation in these areas. The Environment Agency liaises with the conservation officer of the City council over any proposals relevant to these sites.

Wembury Voluntary Marine Conservation Area - The foreshore and subtidal area around Wembury is managed in a non-statutory way by an advisory group, whose aims are to promote conservation and study of the area and to promote education of the public, students, etc. in sustainable marine conservation. This area has rich marine life which has been studied for many years.

Rare and Threatened Species

A number of vulnerable wetland species occur within the catchment. These include kingfisher, otter, dipper, avocet, black tailed godwit and triangular club-rush. Such species will require special protection and promotion through Biodiversity Action Plans (see Section 5.3, page 126).

4.1.3 Historic Environment

Designated Sites

Scheduled Ancient Monuments (SAMs) - There are numerous SAMs within the catchment, with notable concentrations occurring on Bodmin Moor and Dartmoor. Five bridges within the catchment are designated as SAMs, which are of particular relevance to the Environment Agency. SAMs are of national importance, protected in law. English Heritage advises the Secretary of State for the Department of National Heritage on matters relating to SAMs. They are given full consideration by the Environment Agency in any relevant Agency authorisations and

CATCHMENT USES

developments. There are also many more unscheduled ancient monuments that can be of national, regional or local importance.

Area of Great Historic Value (AGHV) - Large parts of Bodmin Moor and Rame Head are designated as AGHVs by Cornwall County Council, in recognition of the concentration of archaeological interest.

Historic Settlements - Parts of St Germans, Saltash, Callington and Forder in Cornwall and Horrabridge, Bere Ferrers and Tavistock in Devon are designated Historic Settlements. These are of county importance for archaeological conservation, both above and below ground. As with AGHVs, these are afforded special protection in the County Structure Plans. There are two designations in the Plymouth City Council Local Plan, Historic Urban Areas and Non Urban Historic Landscape, which recognise the value of the historic environment.

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

Within the estuary and coastal waters there is an extremely valuable resource of old fortifications and numerous sunken wrecks, including the protected Cattewater and HMS Coronation wrecks.

The Environment Agency 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 EA licences to undertake abstractions, discharges or works, are required to carry out their own search.

4.2 Fisheries

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

Our Objective: To maintain, improve and develop fisheries.

The Role of the Environment Agency

We have duties and powers to:

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

We are involved in a range of activities:

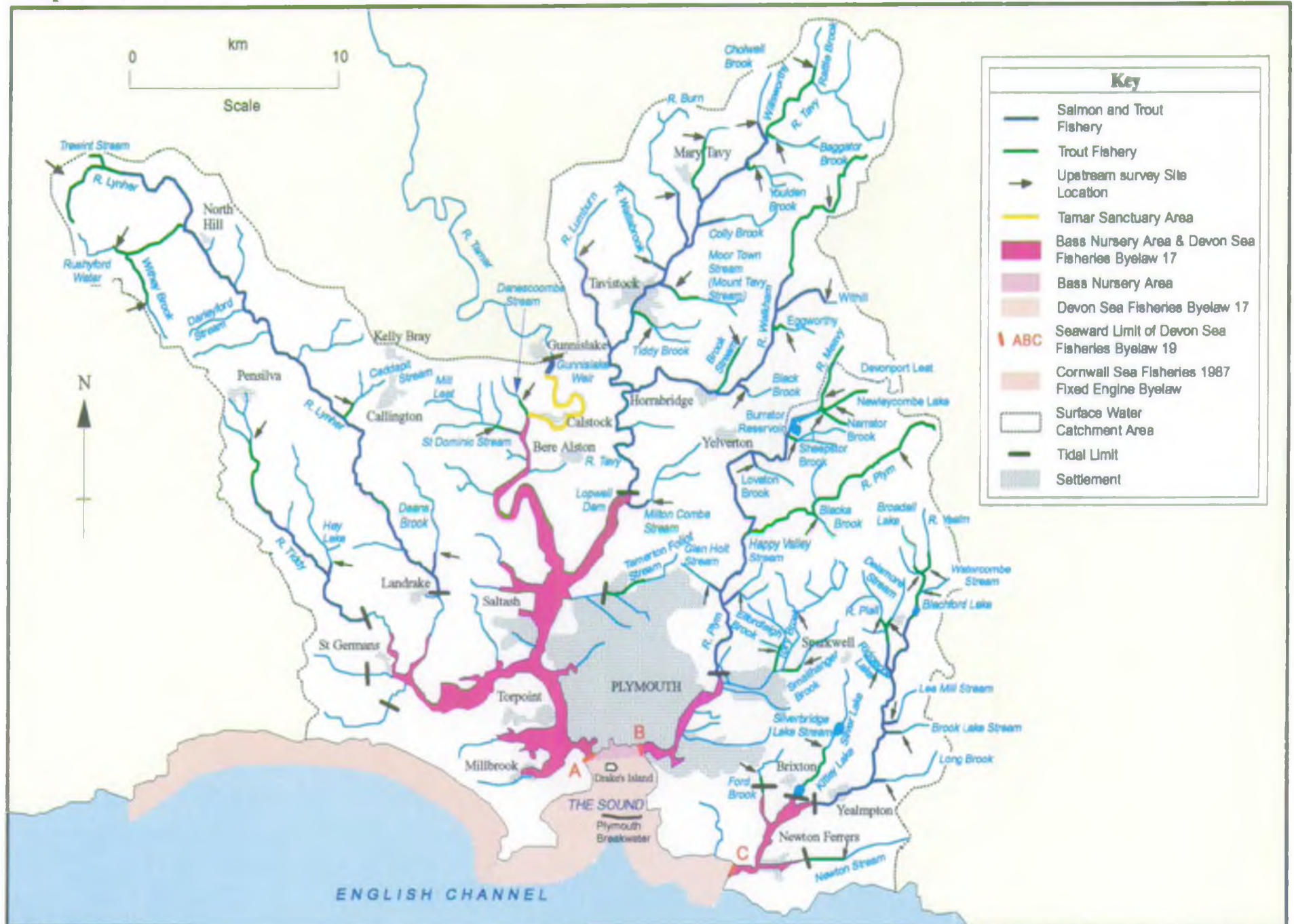
- * liaison with other organisations with a role to play in the protection and management of inland and coastal fisheries
- * maintaining effective links with local authority planning departments to ensure fisheries are not adversely affected by development plans
- * prevention or limitation of fish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

4.2.1 Local Perspective

The Tamar Estuary supports a tidal fishery for Atlantic salmon and sea trout for a mile downstream of Gunnislake weir. Below this point a sanctuary area (see Map 6) gives a temporary refuge for migratory and other fish species between the net fishery and rod fishing.

The Rivers Tavy and Lynher and their tributaries support good fisheries for Atlantic salmon, sea trout and brown trout throughout their freshwater length. The River Plym supports a fishery for Atlantic salmon, sea trout and brown trout. Burrator Reservoir, which separates the River Meavy (a Plym tributary) from its headwaters, is stocked with brown trout and rainbow trout. The River Yealm supports a fishery for sea trout and brown trout from the upper reaches of the estuary to its headwaters and those of its tributaries. A small run of Atlantic salmon exists on the Yealm mainly entering the river late in the season. As it is a small run it becomes more sensitive to impact.

Map 6 - Fisheries



CATCHMENT USES

All the rivers contain self sustaining populations of fish in addition to salmonids, most commonly eel, bullhead and brook lamprey. Densities vary within the different river systems. Species recorded in fisheries surveys are listed in Table 4.

Fisheries Surveys

Fisheries surveys have been carried out at various sites in the catchment since 1968. The table below summarises the species found by subcatchment. The latest known distribution of juvenile salmon and trout is shown on Map 6 (Note : The fishery may extend further than indicated but we do not mark as such, and unmarked watercourses are not surveyed). Further details of fisheries surveys can be found in Appendix B.

Table 4: Fisheries Surveys

Subcatchment	Date surveys began	Species found
Lynher	1968	Atlantic salmon*, sea /brown trout, bullhead*, Eel, brook lamprey*, sea lamprey*
River Tiddy	1980	Atlantic salmon*, sea/brown trout, bullhead*, eel, brook lamprey*
Tamar Estuary	Not Surveyed	Atlantic salmon*, sea trout, grayling*, dace Marine species - eel, shad*, sea lamprey*, smelt and many others
River Tavy	1970	Atlantic salmon*, sea/brown trout, bullhead*, eel, brook lamprey*, minnow, stone loach
River Plym	1971	Atlantic salmon*, sea/brown trout, bullhead*, eel, brook lamprey*, three spined stickleback
River Yealm	1977	Atlantic salmon*, sea/brown trout, bullhead*, eel, brook lamprey*, minnow, dace

* EC Habitats Directive listed fish species

In addition to its value as a natural resource, the fishery also generates income for the local economy through being able to support active net and rod fisheries. We are not aware that the actual importance to the economy has been calculated. National studies however indicate that the value is likely to be significant.

Net fishery - Lynher, Tamar and Tavy Estuary

The Tamar Estuary, along with the Tavy and Lynher Estuaries, sustains one of the most productive net fisheries in the South West. July is the most productive month for the netsmen coinciding with the main runs of grilse into the estuary.

Net catches of sea trout peak in May (closely followed by June) with catches comprising of larger sea trout (multiple spawners or large maiden fish). The larger numbers of school peal which run the rivers in July and August pass through the net meshes relatively unhindered due to their smaller size.

CATCHMENT USES

Further information on net catches is given in Appendix B.

Rod Catches

The Tamar Estuary and Tavy and Lynher rivers have a good run of salmon. Grilse and two-sea winter fish form the majority of the population. Three-sea winter fish and previous spawners are very occasionally caught. Historically sea trout catches from the River Tavy have been excellent and often many times the catches from neighbouring rivers. In recent years reduced Tavy catches have been more similar to those of the Lynher, Tamar and Plym. Sea trout rod catches usually peak in July and August which coincides with the main run of school peal (sea trout up to 1.5 pounds weight returning from sea for their first spawning).

The Plym has a moderate run of salmon with the majority of fish caught in November and December. There is a good run of sea trout with rod catches peaking in July and August coinciding with the run of school peal, although good numbers of larger sea trout are caught early in the season.

The Yealm has a moderate run of sea trout and records minimal salmon catches with the exception of 1994 when 17 were reported.

Further information on rod catches is given in Appendix B.

Spawning

River Lynher

Salmon spawning occurs throughout most of the Lynher, except in the headwaters and the majority of the Withey Brook. Extensive sea trout and brown trout spawning occurs upstream of Trebartha peaking around the highest survey sites.

Salmon spawn throughout much of the Tiddy, but consistently low juvenile densities suggest either few spawning adults or water quality problems. Key sea trout and brown trout spawning occurs upstream of Treweatha.

Tamar Estuary

Spawning by late run salmon in March has been observed below Gunnislake Weir. The presence of salmon parr and no salmon fry in the lower part of the St Dominic Stream suggests salmon spawn there sporadically. Sea trout also spawn in this stream and on the Danescombe Stream.

River Tavy

Salmon spawn throughout much of the Tavy system. In the main river their upstream limit appears to be Coffin Wood (SX 540 810). In all the Tavy tributaries upstream migration is usually limited by major waterfalls or manmade obstructions, depending on flow conditions. There is no evidence of salmon spawning in the Tamerton Foliot Stream. Principal sea trout and brown trout spawning areas are in the headwaters of the main river and especially in the tributaries. However the extent of sea trout usage of spawning gravel beyond Tavy Cleave has not been established.

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River Plym

Salmon spawn throughout the River Meavy (downstream of Burrator Reservoir) and to a lesser extent in the main Plym downstream of the Meavy/Plym confluence. There is no evidence of salmon spawning successfully on the main Plym upstream of the Meavy/Plym confluence and this is considered due in part to the arduous ascent through Dewerstone Gorge and the natural water quality fluctuations to very low pH levels. Extensive sea trout and brown trout spawning occurs in the Meavy subcatchment and above Cadover Bridge (upstream of Dewerstone Gorge).

River Yealm

Salmon spawn throughout the Yealm as far as Blachford Lake (built 1827). Salmon spawn sporadically in the River Piall, Ridgecot Lake Stream and Longbrook. Sea trout and brown trout spawning is usually concentrated upstream of Blachford Lake, although spawning occurs throughout the Yealm. The River Piall and the Silverbridge Lake Stream are also well utilised.

Full details of juvenile survey results for the catchment are given in Appendix B.

Trends in Abundance

Since the early 1970s the proportion of grilse to two sea winter salmon has altered and there is now a much higher proportion of grilse in the Lynher, Tamar and Tavy populations. This change may be cyclical, climate dependent or related to fishing on the high seas strongly selecting multi-sea winter fish. The outbreak of Ulcerative Dermal Necrosis (a fish disease) in the early 1970s had a detrimental affect on the survival of spring salmon.

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

A 1995 NRA report on spring salmon stocks in the rivers of Devon and Cornwall (The Status of Spring Salmon Stocks in Devon and Cornwall - Fisheries Technical Report, Ref 5) demonstrated similar trends for all the major salmon rivers. Based on net catch data, the decline on the Rivers Tavy and Tamar were the second and fourth most serious. Annual salmon scale readings of a significant proportion of the rod and net catch is required to follow any further changes in the components of the Lynher, Tamar and Tavy salmon stock.

Too little historic information exists on the various ages of River Plym and River Yealm adult salmon to determine any long term changes in abundance of different ages within the adult stock.

No evidence of trends in abundance of adult sea trout can be determined from the limited data set of scaled sea trout currently available.

Introductions and escapees

Freshwater fish surveys have revealed rainbow trout and rudd in the River Plym, rainbow trout in the River Tavy, a carp from the Morewellham Canal and a rainbow trout on the River Yealm. The dace stock within the Silverbridge lake stream is self-sustaining but of an unknown origin. Dace have also been found below Gunnislake weir. Fish surveys have not revealed any non-native fish species in the Lynher or Tiddy.

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Three species have been caught in the estuary, and are almost certainly all escapees from enclosed waters. Rainbow trout are the only non-native Tamar freshwater fish species that can also live in the marine environment. We have concerns that these may compete with and introduce disease to the native fishery.

Stocking

A national Environment Agency stocking policy is being developed.

Obstructions to migratory fish

Obstacles that are impassable or partially impassable, both natural and man-made are dealt with in Section 5.3, page 131.

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 Environment Agency national rod licence* and permission from the owner of the fishery.

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

There are many other legal requirements relating to fisheries matters. Information is available from the Fisheries Department, Environment Agency Cornwall Area Office, Victoria Square, Bodmin.

Byelaws

The catchment's fisheries are protected by many byelaws. A full list is available from the Fisheries Department. Table 5 below shows the rod fishing open seasons i.e. the period when it is permitted to fish in the river.

Table 5: Open rod fishing seasons

Species	River Lynher	Tamar Estuary	River Tavy	River Plym	River Yealm
Salmon	1 Mar - 14 Oct	1 Mar - 14 Oct	1 Mar - 14 Oct	1 Apr - 15 Dec	1 Apr - 15 Dec
Migratory trout	3 Mar - 30 Sep	3 Mar - 30 Sep	3 Mar - 30 Sep	3 Mar - 30 Sep	3 Mar - 30 Sep
Brown trout	15 Mar - 30 Sep	15 Mar - 30 Sep	15 Mar - 30 Sep	15 Mar - 30 Sep	15 Mar - 30 Sep
Rainbow trout	15 Mar - 30 Sep	15 Mar - 30 Sep	15 Mar - 30 Sep	15 Mar - 30 Sep	15 Mar - 30 Sep
Coarse fish	16 Jun - 14 Mar	16 Jun - 14 Mar	16 Jun - 14 Mar	16 Jun - 14 Mar	16 Jun - 14 Mar

Within enclosed still waters there is no close season for coarse fish, eel or rainbow trout unless one is imposed by clubs or fishery owners.

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The Environment Act 1995 allows fisheries regulators to make byelaws to control fisheries for environmental reasons as well as for fisheries management. The duty to have regard to the conservation of marine flora and fauna from the Sea Fisheries (Wildlife Conservation) Act 1992 remains, thus conservation implications must be considered for fisheries management byelaws as well as for environmental ones.

Habitat Improvements

Work has been done on gravel improvements and trash dam clearance at a number of locations throughout the catchment. (See section 5.3, page 129)

Estuarine Fisheries

The Ministry of Agriculture, Fisheries and Food (MAFF) with the Fisheries Departments for Wales, Scotland and Northern Ireland has responsibility for the conservation of fish stocks and the management of marine fisheries in UK/British waters. The main management tool is the EC Common Fisheries Policy, which applies to fish stocks in coastal as well as offshore waters and endeavours to maintain them as a renewable resource.

Sea fisheries in the estuarine and coastal waters of England and Wales, out to 6 miles, are regulated by Sea Fisheries Committees (SFC) established under the Sea Fisheries Regulation Act 1966 and, in the case of migratory stocks by the Environment Agency. The Devon Sea Fisheries Committee (DSFC) regulates sea fisheries within the estuarine and coastal areas of this document. All byelaws made by these bodies have to be confirmed by the appropriate Minister. SFCs, in common with other fisheries managers in the UK (including the Environment Agency), may regulate for strict fisheries management purposes as well as for the more general protection of the marine environment. An outline of relevant legislation is given below with further details in Appendix B.

DSFC byelaws 17 and 19 restrict the use of nets (Appendix B). We also restrict the use of nets with Section 6 of the Salmon and Freshwater Fisheries Act 1975 (SAFA 1975) and Section 33 of the Salmon Act 1986 (SA 1986). Both Acts contain restrictions relating to the use of fixed engines (Appendix B). SAFA 1975 also restricts the use of rod and line.

MAFF made two orders which enabled the designation of protected nursery areas for sea bass. They include the estuaries of the Lynher, Tamar, Tavy, Plym and Yealm. They came into force in 1990 and are:

1. The Sea Fish (Specified Sea Area) (Regulation of Nets and Prohibition of Fishing Methods) Order 1989: SI 1989 No 1284.
2. The Bass (Specified Areas) (Prohibition of Fishing) Order 1990: SI 1990 No 1156. (As varied).

Studies of 0+ and 1+ juvenile bass (ages of fish) within the Landulph Marsh area have been carried out annually by private individuals (Mr. Donovan Kelley and associates), since 1984. These studies have identified weak and strong year classes of juvenile bass within the time period studied and show that estuaries are the nursery areas for coastal and offshore bass populations (Ref 6). Colder summers and particularly severe winters reduce survival rates of the 0+ and 1+ stages. Prior to 1990 extensive daylight gill netting for juvenile bass was common in the Tamar Estuary. It may be that this has been replaced by illegal night time gill netting, though at a lower rate.

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Although the above regulations legally protect juvenile bass within the nursery areas it is difficult to prove that juvenile bass survival has greatly improved. Illegal netting of undersized bass still occurs within these sanctuary areas. Policing of the estuaries is actively carried out by the Environment Agency, DSFC, MAFF and the Port of Plymouth Ministry of Defence Police.

Other fish species identified by Mr D. Kelley whilst netting a high tide mark for 0+ and 1+ bass at Landulph Marsh include juvenile grey mullet species, sand gobies, flounder, herring and adult smelt (in spawning condition).

The Tamar Estuaries Management Plan (Ref 7) contains the objectives of increasing awareness of rules and regulations governing fishing within the estuary, and reviewing the implications of crab trapping. We are identified as a body requiring involvement in implementation.

Shellfisheries

The operation of shellfish beds requires the lease of the sea bed from the owner of the fundus (the channel bed below high water mark). Additionally to protect the shellfish beds from other activities which may be damaging to cultivation, 'Several' or 'Regulating' Orders may be sought. Both are granted by government, after application to MAFF, and give protection for specified species and areas for a number of years.

There are shellfish beds for oysters and mussels registered under the EC Shellfish Hygiene Directive (see Section 5.1 for list) in the Yealm, Tamar and Lynher Estuaries which reflect historic use. At present there is only stock in the Yealm and Lynher, and only the Yealm is being harvested. An application has been made for a Several order on the Lynher, though consideration is being deferred until rights to use the bed is established.

The limiting factor to the development of shellfisheries is water quality. This has been focused particularly on bacteriological quality which dictates the treatment required before shellfish can be sold (see page 103). Water quality in the estuaries has historically been affected by numerous crude discharges. Improvements have and will be made for compliance with the EC Bathing Waters and Urban Waste Water Treatment Directives, see Sections 4.12 and 5.1. This may result in the reclassification of the shellfisheries to make them more viable. If this were the case it could be expected that there would be greater interest in establishing shellfish beds. However there may be other constraints on expansion, such as access, alternative uses and infrastructure, which would need consideration. The proposed designation of the Special Area of Conservation (see Section 4.1) does not prevent development of the shell fishery. Full designation might however alter the control and management of existing operations and any future development, both currently undertaken by MAFF and DSFC in consultation with other groups.

In the production of this document we have become aware that on the Yealm there is a perceived problem with the shellfish beds being impacted by tributyl tin (TBT). We have noted the presence of TBT in the Yealm through the Dangerous Substances monitoring programme, see Section 5.1. However we only monitor at one location and cannot draw conclusions for the whole of the estuary. The concerns should be addressed within any investigation which might be carried out.

4.3 Agriculture

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

Our Objectives

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

The Role of the Environment Agency

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

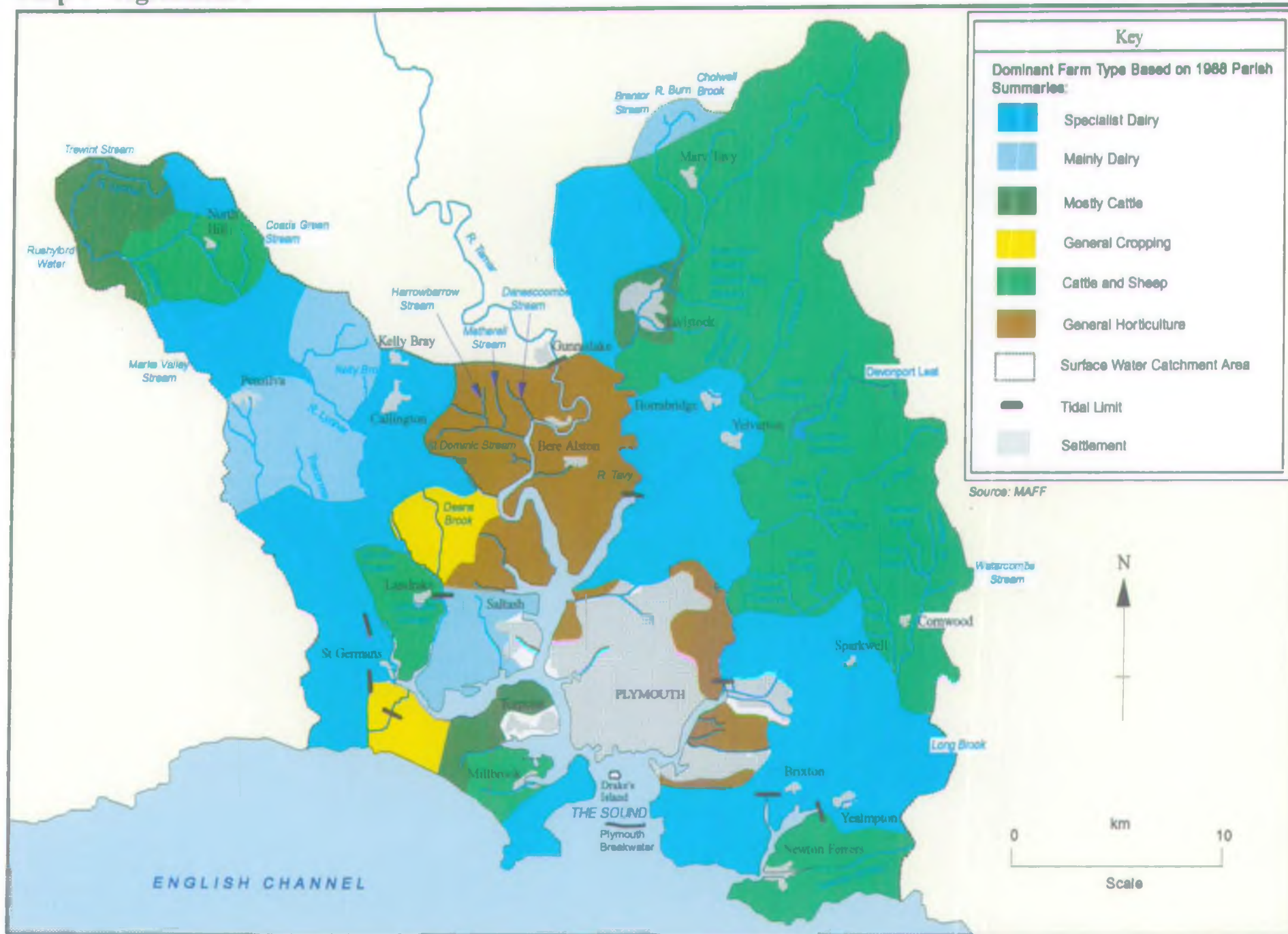
We have duties and powers to:

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

Our work involves a range of activities:

- * we assess the impact of farming on water quality, prioritizing our work where there are gaps in our knowledge
- * we visit farms so that pollution can be prevented
- * we are developing best practices to prevent pollution from the storage and disposal of farm wastes, and from the management of farmland. These best practices will include measures such as buffer zones or other schemes to prevent pollution and improve rivers and wetlands for wildlife
- * we inform farmers and the public about the pollution problems caused by farming
- * we work with other agencies such as MAFF to make the most of our pollution prevention work
- * we encourage farmers to use the Codes of Good Agricultural Practice for the Protection of Water and Soil (Ref 8)
- * we urge farms to use the free pollution prevention advice available from ADAS on behalf of MAFF.

Map 7 - Agriculture



Information correct as of November 1995

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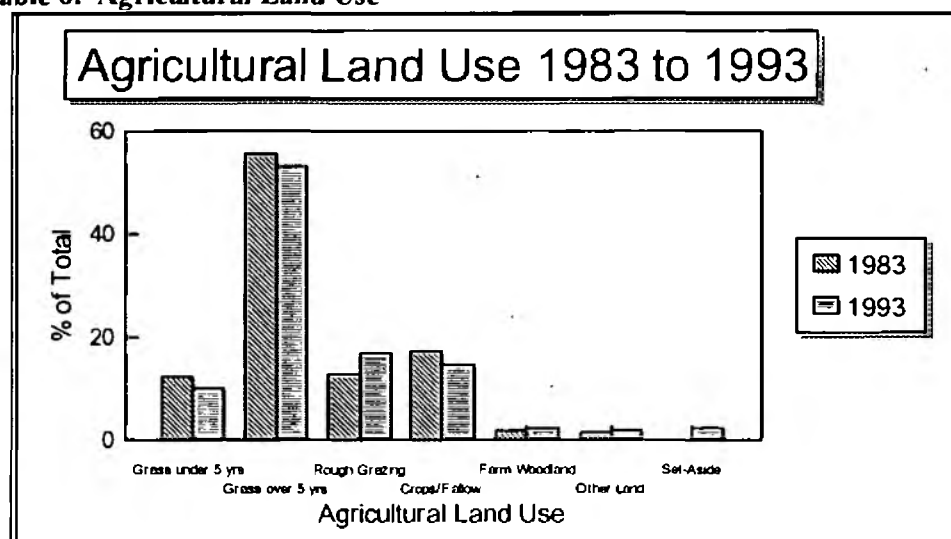
4.3.1 Local Perspective

Agricultural land covers approximately 67,000 hectares of the catchment, almost 70% of the total area. There has been an apparent increase of approximately 7.6% in the total area of agricultural land, which may represent the inclusion of MoD land on Dartmoor in 1993.

The majority of the agricultural land, approximately 80%, is grassland, see Table 6. The composition of grass types are reflected in all the main river subcatchments with some variations, such as increase in rough grazing on the moorland fringes. (Source: MAFF, Land Use Planning Unit).

The reason for the dominance of grassland lies largely in aspect, climate and soils of the catchment. Soils within the catchment generally hold water longer and are less likely to dry out than the national average. A reduced response to drought means less need to irrigate and generally lower demand for water from agriculture within the catchment.

Table 6: Agricultural Land Use



Farm Types

Livestock farming is the dominant farm type in the catchment (see Table 7) and data shows a number of trends in farm types.

The number of dairy farms has fallen by almost 30% whilst cattle and sheep farms have increased.

The dairy herd in the catchment has fallen over ten years by 21% but there has been a dramatic increase of 48% of beef cattle. A 22.5% increase has been seen in numbers of sheep. These changes may reduce the use of fertilizers and general pollution load from dairy farming, however a reduction in the total number of dairy units is offset by remaining units getting larger, which can increase the impact of any pollution incident.

Generally there have been reductions in all forms of horticulture except within the Lynher subcatchment where hardy nursery stock, bulbs and flowers and areas under glass or plastic have increased. In this area there may be implications from such activity for applications for water abstraction licences, see Section 5.2. Reductions in horticulture have been limited in the

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traditional areas bordering the Tamar Estuary which grow fruit, early vegetables and flowers.

Long term trends

Long term trends indicate that the movement to two types of holding, part-time farms and 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, though larger farms are likely to be better financed to handle farm waste. The smaller holdings are becoming part-time and interest in diversification schemes will increase to maintain employment and incomes. Farm diversification can have various impacts on the water environment and concerns for the Environment Agency: i.e. pond creation and sewage treatment, and we would look for adequate consultation where such impacts are likely.

Reforms in the Common Agricultural Policy and milk marketing are likely to exacerbate these trends, with livestock farmers gaining the greatest benefit in the short term. Parts of the catchment receive additional support through other schemes such as the Environmentally Sensitive Area (on the Dartmoor fringe) where payments are made to support more traditional, environmentally sensitive practices. The level at which these will affect the current use of land is not known but expected to be relatively small.

Grants for installing or improving farm waste facilities have been removed which leaves the full cost of further improvements with farmers. Limited non-chargeable independent pollution advice continues to be available from ADAS and we urge farmers to take advantage of this service.

Table 7: Farm Types

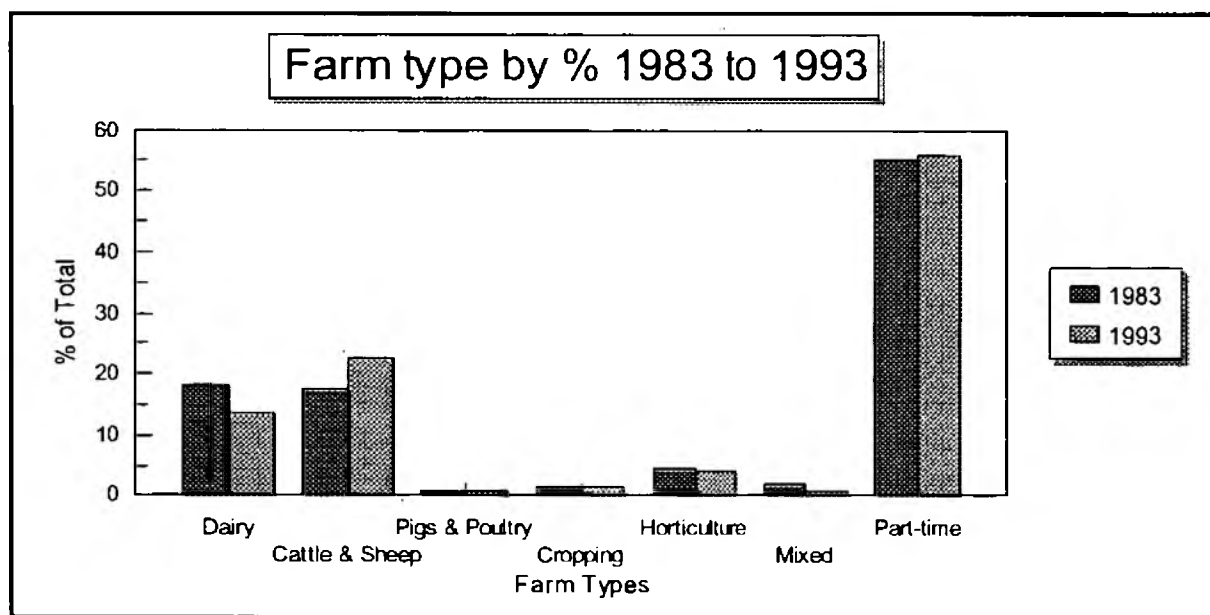
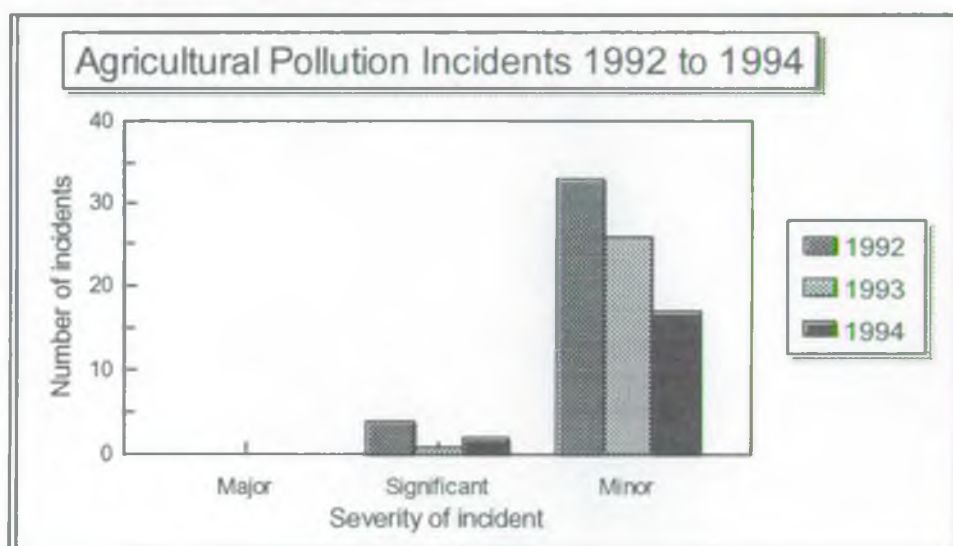


Table 8 shows a continuing decline in the numbers and severity of pollution incidents relating to farming. This has probably resulted from the extensive, proactive pollution prevention work carried out by the Environment Agency and the subsequent positive response from the farming community. However, farming continues to have an impact on water quality within the catchment (See Section 5.1.1).

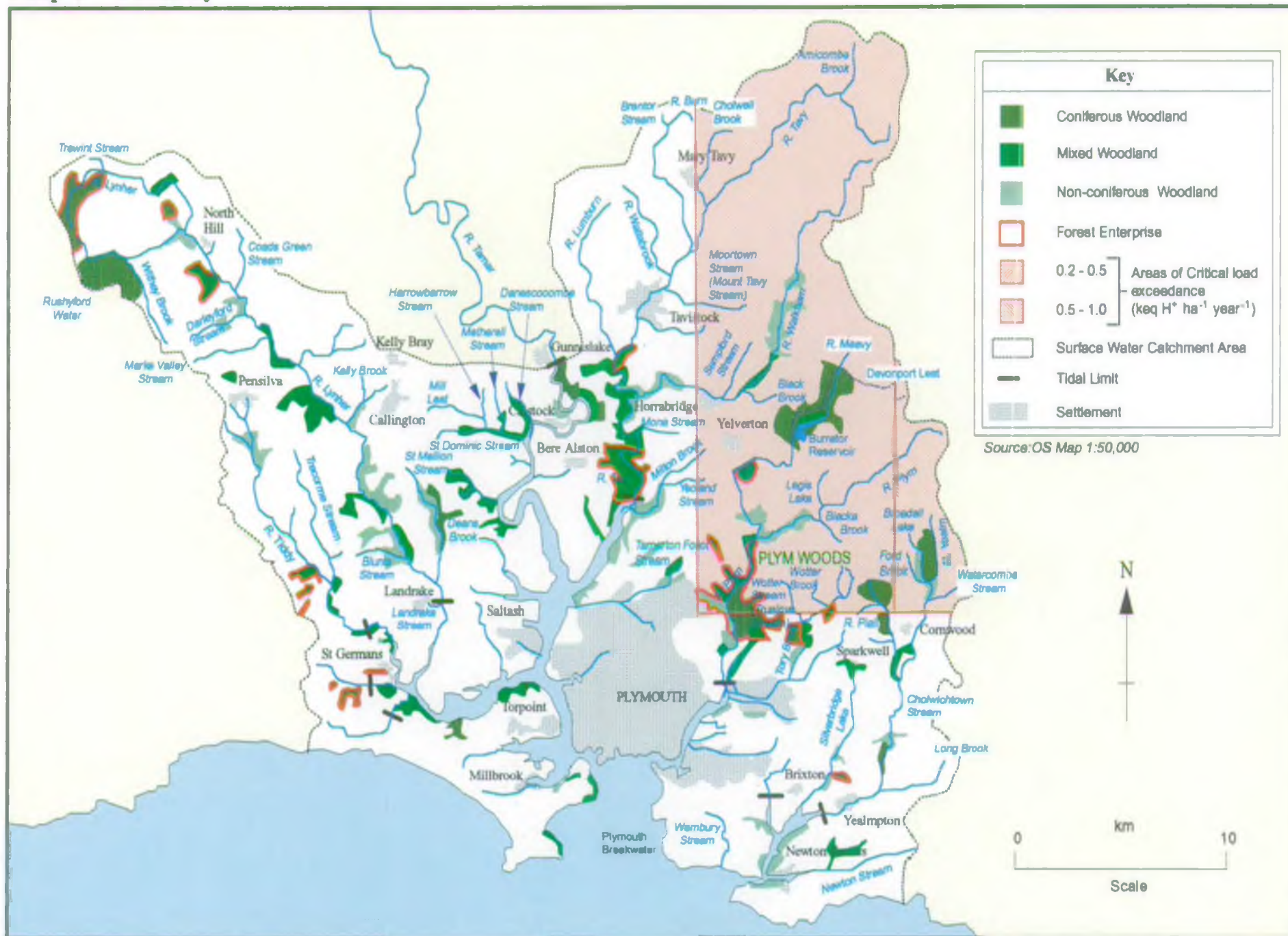
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Waste-spreading to land in the catchment may be an issue in the future. Land is already used for the disposal of agricultural wastes (exempt from licensing under Waste Management Regulations 1994, Ref 9) and sewage sludges (which fall under the Sludge (Use in Agriculture) Regulations 1989, Ref 10). In 1998 the disposal of sewage sludges at sea will be prohibited by an EC Directive. This could increase the loading to land, which may result in an increase in pollutions associated with land runoff. The Environment Agency will recommend the use of the Code of Good Agricultural Practice (Ref 8) for the management of spreading (see Section 4.13).

Table 8: Agricultural Pollution Incidents



Map 8 - Forestry



4.4 Forestry

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

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

Our Objectives

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

The Role of the Environment Agency

We have duties and powers to:

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

Further initiatives the Environment Agency is associated with include:

Improving consultation

- We are currently consulted on a non-statutory basis by the Forestry Authority in respect of applications under the Woodland Grant Scheme in relation to acid sensitive areas documented in the 'Forest and Water Guidelines' (Ref 11). The Forestry Authority may require a formal Environmental Assessment for significant new planting schemes. We are seeking improved links with the Forestry Authority to achieve a consistent and effective approach to the general environmental assessment of forestry schemes and operations. This should include felling and restocking which may have effects on the water environment comparable with new planting
- The Environment Agency should be consulted if there is significant planting within the 'main river' floodplain. Formal consent will be required under Land Drainage Byelaws
- We will continue liaison with relevant local authorities on planting applications and in the production of Indicative Forest Strategies to ensure the water environment is taken into consideration
- The existing ad-hoc liaison arrangements which exist between the Environment Agency and forest managers, such as Forest Enterprise and Forestry Authority officers, will also be further developed.

Best Practice

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

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4.4.1 Local Perspective

A Forestry Authority census of British woodland is in progress and the South West counties will be covered over the next few years. Much woodland in the catchment was originally ancient natural and semi-natural. Some of these deciduous woodlands are of national and regional conservation interest, and designated as SSSIs and county wildlife sites. Over recent years however much of the ancient woodland has been replanted, largely with conifers, though there are still a number designated for their conservation interest. Designated sites are marked on Map 8. (See Section 4.1)

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

Some of the woodland in the catchment is situated on thin moorland soils in areas of high rainfall and high winds. The combination of these relatively hostile factors has led to monocultures of predominantly Sitka spruce. The more fertile and sheltered valley sites contain a larger element of broadleaf trees, particularly along streams and rivers. The Lower Tamar valley near the tidal limit has a microclimate ideally suited to growing trees.

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.

Some forestry within the catchment is owned or managed by Forest Enterprise (the operational arm of the Forestry Commission). This is managed with a commitment to improve landscape and conservation value and public access, unless any such activity is prohibited by conditions of a lease agreement. The most significant recreational sites are Plym Woods in the Plym valley and around Burrator Reservoir. The Commission's medium and long term plans alongside watercourses aim to introduce more diversity in species and age classes of trees (both coniferous and deciduous) to produce habitats appropriate to a site. This will be achieved through introducing open space, manipulation and management of existing vegetation, and, as a third option new planting.

There is an identified Critical Load area on the edge of Dartmoor which includes the upper reaches of the Rivers Tavy, Plym and Yealm. This is an area, designated by the DoE where sulphur levels, causing acidification (low pH), are considered to be impacting on the ecosystem - see glossary. Any proposals for new plantings within this area may require an Environmental Assessment to assess whether the forestry proposal would exacerbate the problem of low pH. In addition to new planting, forestry activities on existing sites (particularly harvesting) may cause a short term reduction of pH. Particular sites are at the head of the Rivers Yealm, Piall (Yealm), Plym, Meavy (around Burrator), Walkham and Withey Brook. In these areas acidity of the water, though derived from natural causes, is currently of concern to the Environment Agency. These are identified in Section 5.1 and we would wish to be consulted prior to any new planting.

In this catchment, as in the rest of Cornwall and West Devon, the greatest potential for problems to the watercourse arises from pollution caused by careless harvesting. The Forestry Authority, which licenses felling, is aware of the general problem and advises applicants with reference to 'Forest and Water Guidelines'. There are forestry plantations adjacent to metaliferous mining areas such as Devon Great Consols. These sites need a cropping plan that has been discussed with the Environment Agency.

4.5 Recreation and Amenity

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

Our Objective

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

The Role of the Environment Agency

We have duties and powers to:

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

We are involved in a range of activities:

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

4.5.1 Local Perspective

Much of this catchment has a high level of water-related recreational use. Two recent surveys have detailed the use of the Tamar Basin for recreation, and to save duplication here these should be referred to:

- 1) Review of the Port of Plymouth Area Recreation Study, 1992. (Concentrates on sailing).
- 2) Recreational Usage and Issues on and around the Waters of Plymouth and the Tamar Basin, 1994. (Concentrates on important recreational activities on water and adjacent banks, excluding sailing).

Within the catchment the coastal and estuarine areas provide the major focus for water-based recreation. Outside of the area covered by the two documents listed above, the following activities take place:

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Bathing Beaches

There are a number of bathing beaches within the catchment which are heavily used. Of principal concern regarding this use is water quality. This is dealt with in detail in Section 5.1, pages 93 and 108.

In addition to bathing beaches, the Plym is used for recreation at locations on the freshwater section as well as in the estuary.

Angling

The Rivers Tamar, Tavy and Lynher are nationally recognised salmonid fisheries with angling taking place throughout much of the catchment. The Tamar Estuary supports a tidal fishery for salmon and sea trout for a mile downstream of Gunnislake weir. There is a river game fishery for salmon, sea trout and brown trout on the River Yealm and River Plym. The fishing rights are owned by fishing clubs and private individuals. There is a riverine coarse fishery on the River Yealm for eel and dace (Silverbridge Lake) and for eel on the River Tavy, River Lynher and River Plym.

All the estuary sea fisheries have various minimum size limits for the most common marine fish species. It is illegal to keep twaite shad, and bass has a minimum size limit of 36 cm. There is no boat angling for bass permitted within the Lynher, Tamar, Tavy and Plym Estuaries (see section 4.2). Boat angling within the Yealm Estuary for legal sized bass is permitted between 31 December and 1 May.

There are several stillwater fisheries throughout the catchment, for brown trout, rainbow trout and coarse fish.

Burrator Reservoir, run by South West Water (SWW), is advertised as one of the most attractive angling venues in the South West. Brown and rainbow trout are the quarry species here, and the site also provides opportunities for birdwatching, walking, picnicking and horseriding. A small lake near Crafhole, also run by SWW, provides coarse fishing for tench and carp.

Environment Agency owned sites

The Environment Agency owns a substantial area of River Tamar fundus (the channel bed below high water mark) in the Calstock area, which provides a number of boat moorings. Other sites owned or leased by the Environment Agency include part of the River Plym. These sites are currently being reviewed by Environment Agency staff to assess their potential for recreational enhancement.

Canoeing

There are access agreements on the Rivers Lynher and Plym between the British Canoe Union (BCU) and riparian owners which enable BCU members to use stretches of river under certain conditions. Canoeing is widespread in the estuaries. The selection of locations, timing of canoe access and numbers of canoeists all need careful consideration so as not to conflict with other river users or sensitive wildlife. While broadly supporting an increase in river recreational use, the Environment Agency insists that proper consideration is given to the above. Where a canoe agreement is negotiated, we can assist with improving safety and information at entrance/exit points.

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Public Paths

The South West Coastal Path traverses the catchment in the south. This designated long distance trail is used by many people throughout the year, but with the highest numbers in the summer. This level of use is putting pressure on the fabric of the path in places. The South West Coast Path Steering Group are currently consulting over their draft strategy. The Cremyll Ferry carries foot passengers across the Tamar.

The local County and District Councils are investigating setting up several long distance recreation footpaths in the catchment including a 'Tamar Trail', which would loosely follow the River Tamar and link various places of interest.

Cycle Routes

A well-used cycle path has been developed on a disused railway line in the Plym Valley. Two other routes in this catchment have been put forward as part of a national programme by the Environmental Transport group 'Sustrans'. These are the Plymouth to Torrington route and the Plymouth to Exeter route. The project is currently subject to a millenium bid and at the time of writing no decision has been made. The Environment Agency is committed to giving whatever help it can to the scheme.

Country Parks

There are two country parks on the Cornish side of the catchment, Kit Hill and Mount Edgcumbe, with outdoor recreation a key function of these areas.

Public Access

Compared to many catchments in the Cornwall Area, public access to rivers in this catchment is fairly well provided for. However, given the large population in the area and its popularity as a holiday destination, some of those areas with public access suffer undue pressure.

A good example of this is Dartmoor, where the National Park is concerned about a number of heavily-used sites such as Plymbridge, Shaugh Bridge, Bedford Bridge, Grenofen Bridge, Cadover Bridge and Burrator Reservoir. The Park Authority is currently looking to draw up management statements for these sites and would look to other agencies to have an input where appropriate.

Developing new recreational opportunities away from such locations would help to maintain environmental quality in those areas currently under pressure. However, parts of the catchment are extremely valuable for many forms of flora and fauna. The Environment Agency would support careful management of increased access to ensure that such activity does not disturb sensitive wildlife habitats.

Issues concerning public access in and around the estuary, for example, public slipways, are dealt with in the Tamar Estuaries Management Plan (Ref 7).

4.6 Aquaculture

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

Our Objective

To protect rivers from the negative effects of fish farms.

The Role of the Environment Agency

We have duties and powers to:

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

Our work involves a range of activities:

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

4.6.1 Local Perspective

There are two fish farms in the catchment, Tavistock Fish Farm on the River Tavy at Tavistock and Milemead Fisheries on tributaries of the River Lumburn.

Authorisations of commercial fish farms in the area have been reviewed by a fish farm control group to ensure that fish farms had all relevant permissions for abstractions, discharges and weirs. Changes in licensing following the Water Act 1989 (Ref 12) had given rise to anomalies that the Group has endeavoured to put right.

Tavistock Fish Farm

The River Tavy at Tavistock Fish Farm sometimes dries up, impacting aquatic animals, preventing the passage of migratory wild fish and causing possible pollution problems. This occurs at times of low flows in the stretch between the abstraction and the discharge points (see Section 5.3 page 121).

A Licence of Entitlement (LoE) for the abstraction was issued by the NRA. Licences of Entitlement were granted under the Water Resources Act of 1989. The NRA were required by law to issue these types of licence on the basis of established use and could not impose conditions to protect the environment. Where such licences cause significant detrimental impacts

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on the water environment or downstream uses, the Environment Agency can negotiate agreement with holders of LOEs for a modification of the abstraction to moderate or prevent any impacts.

The discharge consent will be reviewed in light of the abstraction licence determination as the abstraction volume is very much larger than the discharge volume. The discharge consent at Tavistock Fish Farm is currently being reviewed for administrative purposes (to improve enforcement sampling). Some ponds are built in the floodplain and close to the river. Screening at Tavistock Fish Farm is inadequate and fish can escape from the settlement ponds and at times of high rainfall can escape from two stewponds. Wild river stocks can also enter the fish farm through the outlets and intake (see Section 5.2, page 133).

Milemead Fisheries

Milemead Fisheries has an LoE to abstract from two tributaries of the River Lumburn but has a condition in its licence not to take the entire flow of either stream. At times of low flow fish could have problems in passing the deprived reach. Farmed fish have occasionally escaped at the intake and outlet points at Milemead and wild stocks could enter (see Section 5.2, page 133).

Table 9: Fish farm abstractions/discharges

Fish farm	NGR	Abstraction Licence	Discharge Consent
Tavistock Fish Farm	SX 493 754	8,293,968 m ³ /year	(a) 4,550m ³ /24hrs (b) 1,138m ³ /24hrs
Milemead Fish Farm	SX 444 749	(a) 9,072m ³ /day (b) 216m ³ /day	9,288m ³ /day

4.7 The Built and Developing Environment

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

Globally, it is recognized that human activity and demands are exceeding the Earth's carrying capacity. International concerns and desire for sustainable development culminated in the United Nations Conference on the Environment and Development held in Rio de Janeiro in 1992 where many nations signed up to a declaration of rights and obligations with respect to environment and development, called the "Earth Charter", and an agenda for action, "Agenda 21". The UK Government has responded positively to concerns through its White Paper "This Common Inheritance" (Ref 13) and the Government Planning Policy Guidance. In considering sustainable development policies and strategies, the Agency is keen to promote balanced development, i.e. an appropriate balance between the built and natural environment. This will be achieved through the protection and enhancement of the natural environment and efficient and wise water management.

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

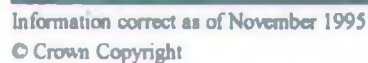
The Role and Objectives of the Environment Agency

The Environment Agency has some limited control over development through its own powers under the Land Drainage Act 1991(Ref 14) and the Water Resources Act 1991(Ref 15), as amended by the Environment Act 1995 (Ref 16) and the Environmental Protection Act 1990 (Ref 17). These relate to the consenting of development in, over or under watercourses, the control of discharges into and abstractions from the water environment (see Section 4.8 and 4.11), the regulation of waste disposal and transfer sites (see Section 4.13) and authorisation of the most potentially polluting processes (see Section 4.14)

The Environment Agency is unable to independently control developments. However, the Agency is a statutory consultee to local planning authorities for development plans and specified types of development proposals. Various DoE planning circulars also identify the Agency as advisors to the Local Planning Authorities (LPAs), in particular 30/92 "Development and Flood Risk"(Ref 18). In order to fulfill the aspirations within the Agency's Mission Statement and to carry out its commitment to sustain all uses of the environment, the Agency will:

- influence development planning by assisting strategic and local planning authorities in formulating policies, allocating development, identifying constraints and highlighting

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- opportunities for enhancement of the environment and guidance notes, such as "Guidance Note for Planning Authorities, NRA, January 1994"(Ref 19).
- 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 environment such as the "Policy and Practice for the Protection of Groundwater"(Ref 20)
- request the Secretary of State to make regulations under the provision of the Water Resources Act 1991,(Ref 15) for example the Control of Pollution (Silage, Slurry and Agricultural Fuel Oil) Regulations 1991(Ref 21).

4.7.1 Local Perspective

Developing Environment

Development Plans. The hierarchy for development plans is:

South West Regional Planning Guidance

County Structure Plans

Waste and Mineral Local Plans

District wide Local Plans

and non-statutory planning guidance such as Area Plans, Development Briefs and Supplementary Planning Briefs.

The South West Regional Planning Conference published a regional strategy for the South West in February 1993. From this evolved the South West Regional Planning Guidance which provides the framework in which each subsequent plan's policies are developed.

In his **South West Regional Planning Guidance (RPG10)** (Ref 23) published in July 1994, and covering the period up to 2011, the Secretary of State for the Environment embraced the principles of sustainable development and advised that:

- 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.
- development plan policies should provide a land use framework for identifying suitable sites for disposal, storage and treatment of waste including the potential for recycling and reducing the amount of waste generated.
- the environmental consequences of development proposals, including the implications for energy, water resources, flood risk, waste disposal and pollution must be a prime

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consideration in preparing development plans, and in the development control process in the region.

The Structure Plans of Devon and Cornwall are currently being updated to roll their policies and proposals forward to 2011.

The **Cornwall Structure Plan Review** Deposit Draft (Ref 3) predicts a housing increase in Cornwall of 45,000 dwellings between 1991 and 2011. It allocates 8,800 new dwellings and 60 ha of employment land to Caradon from 1991 to 2011. Most of this land is in or on the edge of towns.

The First Review of the **Devon Structure Plan** Consultation Draft (Ref 22) predicts 91,000 dwellings between 1991 and 2011. The First Review runs from 1991 to 2011 and allocates 4,700 new dwellings to West Devon, 8,300 dwellings to Plymouth City, 13,500 to South Hams, and 1,000 dwellings to Dartmoor National Park in the Plan period. Employment land from 1991 to 2011 has also been allocated, 36 ha to West Devon, 101 ha to Plymouth and 154 ha to South Hams.

Some of the development required for the period 1991 to 2011 will already have planning permission or be identified in Local Plans. Most of it is, or will be, closely associated with existing settlements. A major proposal of the Draft Review is for the provision of new community in the South Hams area comprising residential (6,000 dwellings), economic and commercial development. This proposal is at a very early stage and it looks most likely that possible sites will be situated outside this catchment.

West Devon

Tavistock and its surrounding parishes are part of the Plymouth economic catchment area, where much of the area's employment, shopping and recreational needs are serviced by the city. Although the strategic planning policy for Tavistock is one of constraint, its role as a local service centre means some additional development over the period 2001 to 2011 is inevitable. Land suitable for employment use has been identified at Wilminstone and at Bere Alston.

Dartmoor National Park

Dartmoor National Park is the planning authority for those parts of South Hams and West Devon which fall within the Park boundary.

Caradon

Saltash and Callington have been identified as Area Centres by Cornwall County Council. The Cornwall Structure Plan forecasts for housing are 1,300 new dwellings in the Callington area, 1,900 in the Saltash area and 900 for Torpoint. Industrial growth is planned for at Callington, Torpoint and Saltash. Caradon District Council has prepared a Planning Brief for the Broadmoor Business Park site at Saltash. Planning briefs will be prepared for Moss Side Industrial Park at Callington and Southdown Brickworks at Millbrook (see also Section 4.10, Contaminated Land).

South Hams

The bulk of South Hams housing allocations fall outside the catchment area. The Local Plan (1991-2001) has allocated 26 ha of employment land for an eastward extension of Langan Industrial Estate. Wembury is identified as being at saturation point for summer tourists.

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Plymouth

In its Local Plan (1992 - 2001), Plymouth City Council raises concerns that the city will only just reach the housing provision requirements of the Devon Structure Plan. Planning Briefs have been prepared for, or will be prepared for, certain sensitive sites. There is a shortage of employment land within the city whilst conservation policies restrain new development outside. Plymouth City Council can only just meet Devon Structure Plan requirements for employment land with no leeway for the implementation of proposals. Development areas such as Roborough and Langage are of major importance to the city but are outside its boundaries. The release of Ministry of Defence (MoD) land at Seaton Barracks provides the potential to add to the stock of future employment land. The potential problems related to redevelopment of industrial sites, such as those in the Cattedown area and reclamation of land alongside the Plym Estuary, are further discussed in Section 4.10, Contaminated Land.

Plymouth Development Corporation are promoting redevelopment of the former MOD land at Mount Wise, Mount Batten and Royal William Yard.

Local Land Use and Planning Initiatives

The more rural part of the catchment is a Rural Development Area and has been designated under European Structural Fund Objective 5b which provides support for rural areas.

We are currently discussing issues with Devon and Cornwall County Councils for the new Structure Plans, Waste Disposal Plan and Minerals Local Plan (Refs 24,25). We are also involved in the emerging Districts' Local Plans (Ref 26). The Environment Agency 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 covering the catchment area have incorporated a number of policies for positively protecting the water environment as a result of early discussions with the former National Rivers Authority.

We recommend formal development restraints in areas where there is inadequate sewerage and sewage treatment systems which result in unacceptable pollution. A schedule of such settlements is presented to the relevant council annually. The recommendations are then used as reference in planning enquiries and applications. A list of settlements in the catchment is given in Table 10. It should be noted that some of these are small in size and impact on the water environment is localised.

The older parts of Plymouth City are served by a sewerage system that discharges crude sewage into the Rivers Tamar and Plym and Plymouth Sound. Normally we would advise the planning authority not to allow new development which drains into these systems or allow redevelopment which might increase the existing foul flows. However, population levels have been decreasing in a large part of this area. We still advise against an increase in overall foul flows but there is obviously potential for development and redevelopment set against this background of historic population decline. SWW's Plymouth Sewerage Scheme (more fully described in Section 4.12, Effluent Disposal) will eliminate these discharges by 1998.

Development restraints are also recommended where there is a threat of new or increased flooding (see Section 4.8).

Water front development issues are carried forward by the Tamar Estuaries Management Plan (Ref 7). The guiding principles of these issues are to work towards ensuring that shore side

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development has full regard to conservation, the local community's needs and other estuarine interests. As a member of the Tamar Estuaries Consultative Forum (TECF) involved in the promotion of the Tamar Estuaries Management Plan we fully support objectives within that plan. We will seek full involvement in the implementation of objectives where we (as NRA) or TECF are identified.

Transport and Road Schemes

The main-line London to Penzance railway runs through the catchment, crossing the Rivers Yealm and Plym and the Tamar and Lynher Estuaries. A branch line runs from Gunnislake to Plymouth crossing the Tamar and Tavy Estuaries on viaducts. There is a proposal to re-establish the former railway from Bere Alston to Tavistock.

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

Particular areas of concern from road developments are:

- pollution risks from spillage of oil and chemicals
- flood risk from surface water runoff
- damage to the amenity and wildlife value of rivers and wetland.
- possible pollution and flood risk during construction.
- effect on water resources through alteration or barriers to groundwater flow.
- disposal of excavated soil and rock.

Proposed road schemes in the catchment:

A38 Saltash to Trerulefoot improvement

The Preferred Route has now been published. We are objecting to the proposed section adjacent to Broadmoor Farm. Although flood alleviation works to alleviate the flood risk in Burraton Coombe and Forder have been agreed, the design calculations did not allow for any surface water runoff from new development in this area. Surface water runoff will therefore exceed the design capacity of the existing flood alleviation scheme and produce an unacceptable flood risk to Burraton Coombe and Forder.

Second Tamar crossing

At the time of writing no decision has been made on whether a second Tamar crossing will be built. The 'Red Route', running parallel with the existing bridge and just upstream of it, was announced as the protected route for planning purposes in May 1994. In October 1995 the Highways Agency commissioned a survey of Tamar travel-patterns which will be used to consider the socio-economic effects of a possible new crossing. It is still not certain whether such a bridge will ever be built and if it is then construction would take place many years in the future, outside the timescale of this Plan.

Industry

Plymouth has been an industrial centre and naval port for centuries and over the years much redevelopment has taken place in the city. The catchment is in the Plymouth travel-to-work area and looks to the city for much of its employment. The economic health of the city, and the

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catchment as a whole is closely linked to the Defence industries. In addition to Plymouth and industrial estates in Saltash, Callington and Tavistock 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 Environment Agency during its winter Task Force operations.

Broadmoor Farm

The proposal to develop this site as a quality business park has been recognised in Caradon District Council's Local Plan, Deposit Version (Ref 26). We have objected to the policy as development would exacerbate the flood risk in Burraton Coombe and Forder. The Council's existing flood alleviation scheme is not designed to accept the increased runoff and afford sufficient protection to downstream properties. Proposals for 'high water-use' developments must also consider adequate treatment and discharge locations, sensitive to the important conservation designations in the Tamar and Lynher Estuaries.

Langage

Over 25 ha of land has been allocated for extension to the east of Langage Industrial Park. Surface water runoff from this new development will discharge into a small tributary at the top of the Silverbridge Lake. This stream runs through the site and flooding will occur along its borders. The Agency has concerns about the effect of this runoff on properties downstream and the A38 culvert if not properly controlled. There is no known flooding of property in the Silverbridge Lake catchment at present.

Industrial processes which we specifically licence and monitor under Integrated Pollution Control are discussed in section 4.14. These are dealt with separately because of their potentially hazardous nature.

Tourism

Seasonal population increases have implications for infrastructure and service provision. Parts of the Cornish and Devon coast lie within Tourist Pressure Areas, where the County Councils' Structure Plans seek to restrain the growth in tourist accommodation in coastal areas that are either especially environmentally sensitive and/or congested. 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.

The Tamar Estuary is a major watersports area. There is considerable pressure for new moorings further up the Tamar, Tavy and Lynher Estuaries which might conflict with the important wildlife habitats to be found there (see Section 4.1, Conservation and Section 4.5, Recreation). The Bere Peninsula in particular has narrow roads and poor communications. The environmental importance of the catchment is reflected in the environmental policies put forward by local Councils in their local plans.

The need to investigate growth of recreation, potential impacts, sensitive habitats and promote responsible behaviour is highlighted in the Tamar Estuaries Management Plan (Ref 7). We fully support the objectives and will seek to help implement them.

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Table 10: Development restraints due to inadequate sewerage infrastructure and/or sewage treatment.

Development Restraints	
Settlement	Reason
Blunts	Current environmental effect caused by effluent discharge, any further increase in flow will cause deterioration of water quality.
Cawsand Kingsand	Crude sewage discharge to estuary causing gross aesthetic nuisance.
Clearbrook	Current pollution of watercourse.
Higher Compton, Plymouth	Storm sewage overflow causes pollution in a watercourse.
Horrabridge parts of Yelverton	Storm sewage overflow causes pollution.
Landrake	Current environmental effect caused by effluent discharge, any further increase in flow will cause deterioration of water quality.
St Germans	Effluent discharge causing gross aesthetic nuisance.
St John	Effluent discharge causing aesthetic nuisance.
St Mellion	Current environmental effect caused by effluent discharge, any further increase in flow will cause deterioration of water quality.
Tavistock	Storm sewage overflows cause pollution and aesthetic nuisance.

4.8 Flood Defence

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

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

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

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

Our Objectives

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

The Role of the Environment Agency

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

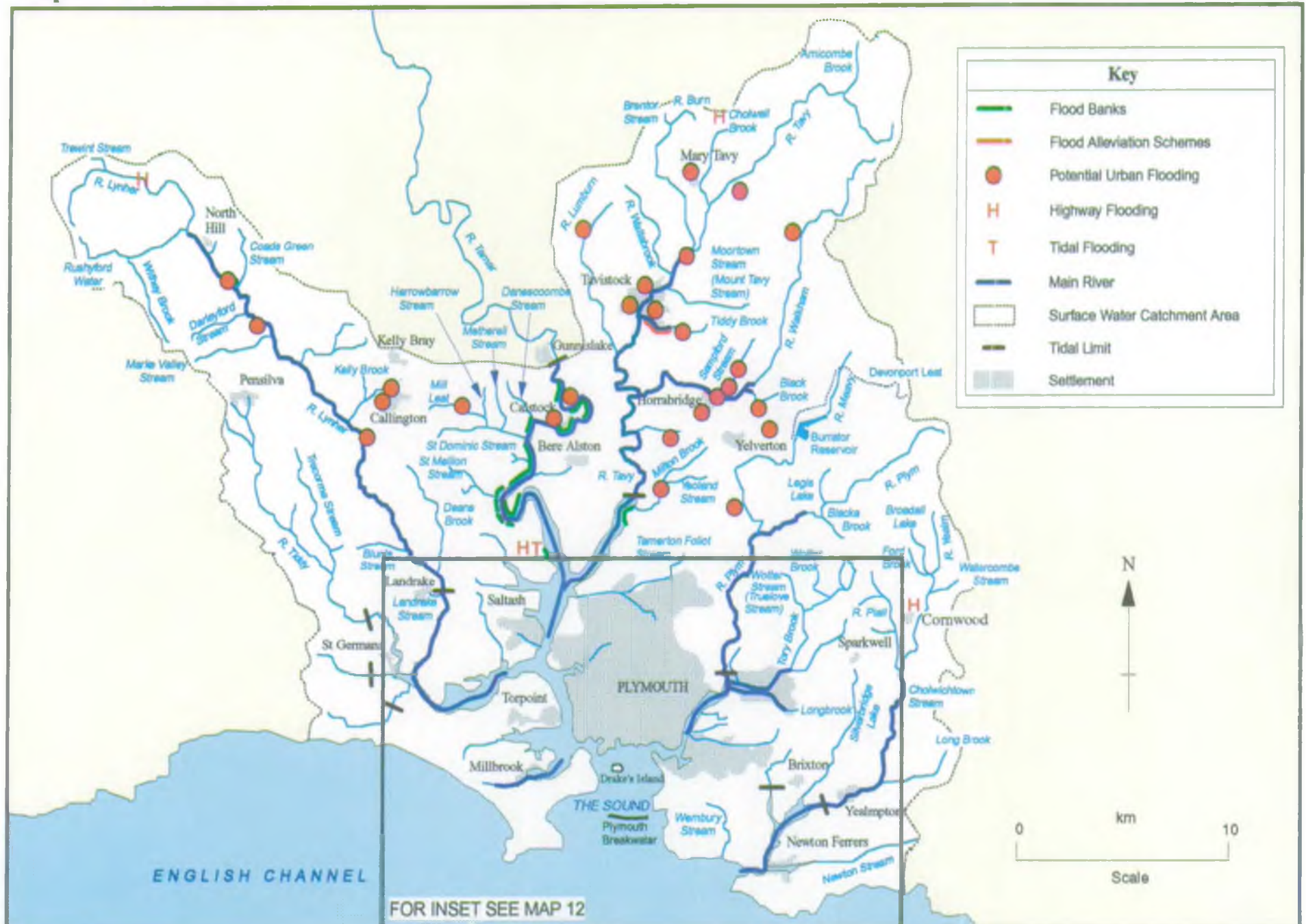
We have duties and powers to:

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

We are involved in a range of activities:

- * we work closely with other agencies including MAFF, local authorities, conservation and recreation bodies
- * we survey assets and flood risk areas to improve our management of flood defence
- * we are working on a Flood Defence Management Framework and related systems to ensure that flood defence assets are managed properly

Map 11 - Flood Defence



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- * we set and monitor specific targets to improve our performance
- * we support Research and Development and are developing best practices for our work.

4.8.1 Local perspective

There are 138.7 km of designated "main river" which are shown on Map 11.

Flooding

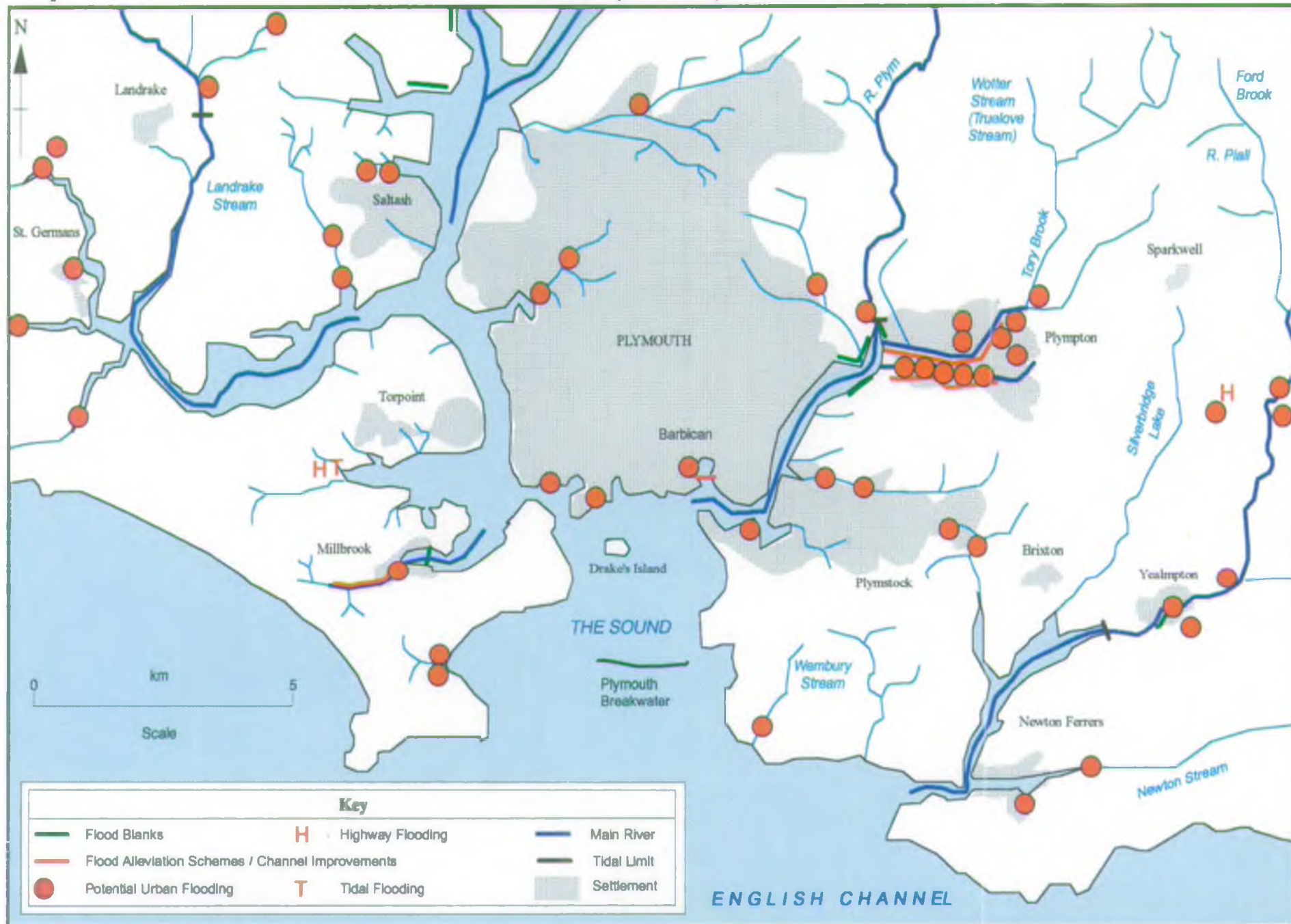
Historically flood defence measures were largely to protect agricultural land. In recent years it has focused on property, particularly Plymouth and its suburbs. There are extensive flood embankments on the tidal Tamar and a number of smaller flood alleviation schemes on other rivers. See table 11 below.

Table 11: Flood defence structures

River	Location	Protection for
River Tamar	Whimble	Grazed wetland
	Ravenscourt	Grazed wetland
	Ferry Farm, Harewood	Pasture
	Calstock	Property, public amenity, rights of way, pasture
	Ward Farm, Ferry Farm	Pasture
	Cotehele	Public amenity, rights of way
	Haymarsh, Greenbank	Pasture
	Halton Quay	Property, public amenity
	Pentillie	Pasture
	South Hooe	Pasture
	Cargreen	Property, public amenity, rights of way
	Landulph	Wetland
	Millbrook	Property, public amenity, rights of way
River Lynher	Bathpool	Property, pasture
River Tavy	Maristow	Pasture
Tiddy Brook	Bishopsmead	Property
River Walkham	Horrabridge	Property
River Plym	Coypool	Property
	Crabtree	Local nature reserve
	Blaxden Meadow	Saltmarsh restoration, public amenity
Tory Brook	Plympton	Property
Longbrook	Plympton	Property
River Yealm	Yealmpton	Property

In addition to these defences, there is a mechanical flood barrier at the Barbican, Plymouth which is operated by the Sutton Harbour Company and jointly maintained with the Environment Agency. There is also a tidal flap within the Millbrook Barrier.

Map 12 - Flood Defence - The Lower Tamar Estuary and Plymouth Sound



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Historic records show that there has been minor flooding in a number of other locations around the catchment (see Maps 11 & 12), the bulk of which affect highways or a very few properties. Most occur on ordinary watercourses where the local authorities have powers to carry out work.

Standards of Service for Maintenance

A system has been developed by the Environment Agency to assess the standard of service needed for Flood Defence maintenance. The system uses the term 'House Equivalents' (HEs) to compare the value of different types of land use (see Appendix D).

The methodology splits the river into reaches. Either side of the river on each reach is assigned a HE value, according to the type of land use (see Appendix D). It then uses a combination of historic flood data and analysed flood data to determine the number of HEs affected per km per year. The higher the score the greater the need for maintenance or a capital scheme. Scores below 0.5 HEs/km/year indicate that maintenance could be reduced. Scores above 1.0 HEs/km/year indicate that maintenance might need increasing. Scores between 0.5 and 1 HE/km/year indicate that the level of maintenance is probably about right.

The system originally only looked at flood damage. However, it is recognized that damage due to waterlogging is important for some agricultural land. Initial recommendations have been provided to include this important factor and further research work is needed. Map 13 shows the land use banding for the catchment.

Maintenance

At present the 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. 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 annual cost of maintenance varies depending on need each year, generally it is of the order of £150,000 to £200,000.

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

The main elements of work detailed in categories 1 and 2 above 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 Environment Agency to view the maps within these documents.

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The floodbanks are all regularly maintained except for those at Whimble, Ravenscourt, Ferry Farm, Harewood (all upstream of Calstock), Landulph, and at Maristow on the River Tavy. Maintenance work is specified more frequently where there is a particular benefit to public amenity.

Debris screens are routinely cleared in Horrabridge, Walkhampton, Plympton and Millbrook.

Maintenance of the river channel banks to maximise capacity is regularly carried out on:

Tory Brook

Millbrook village

Walkham in Horrabridge

Longbrook in Plympton

Tiddy Brook at Bishopsmead, Tavistock

Yealm at Yealmpton

Plym at Coypool

Improvements

In Calstock, the parish council is formulating plans to develop the waterfront. As far as we know these do not require any changes to the present embankments purely as flood defences, although the safety of the development would depend on the continuing integrity of the banks. In Millbrook, a scheme is in hand to provide environmental enhancements around the lake within the tidal barrier, however some capital works have already been carried out by the Agency.

Emergency Response

In general the river systems are able to cope with severe conditions fairly well. Very high tides sometimes affect the waterfront of the built-up areas, just as high river flows extend into the floodplains of the river valleys, although property is rarely affected. In times of high river levels, a watch is kept on the urban areas for obstructions caused by debris. There are sometimes problems on the Lynher around the tidal limit at Notter Bridge arising from a combination of the tide and high flows: local streams south of Hatt and in Rilla Mill have also caused flooding in the past.

The rivers rising on Dartmoor and on high ground nearby have a short response to rainfall in their headwaters. The Longbrook, Tory Brook, Yealm Tavy and Walkham have a particularly rapid response.

Flood Warnings are issued for the following rivers:

River Lynher for Bathpool, Rilla Mill, Notter Bridge

River Tamar for Gunnislake, Morwellham, Calstock

River Tavy for Tavistock

River Walkham for Horrabridge & Bedford Bridge

River Yealm for Yealmbridge & Yealmpton

Longbrook for Plympton

(Flood warning stations are shown on Map 2)

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Rainfall information is available from the Meteorological Office and Environment Agency raingauges. The area is covered both by national weather radar and the site at Predannack on the Lizard, which assists staff in issuing warnings and mobilising in advance of an incident. Passage of flood flows can be monitored by the telemetry in gauging stations shown on Map 2.

South Coast tidal warnings are issued when conditions are expected to cause problems; local action is taken on receipt of these warnings. Information on tide levels is available from gauges at Devonport Dockyard and Sutton Harbour, both in Plymouth.

Regulation

In development terms the area is dominated by the City of Plymouth which has not generated the same flooding problems as an inland town of similar size might have done. This is because of its location adjacent to the tidal waters of the Tamar and Plym Estuaries to which flood water can quickly drain. Over the last fifty years or so the city has expanded to the north and east and the minor watercourses on the perimeter have felt the effects of increased surface water run-off. The Tamerton Foliot Stream and the Longbrook at Plympton are good examples of the effects on a stream of development within its catchment. In both cases increasing urban development in the catchments increased the peak flood flow in the stream due to the more rapid runoff of rainwater from impervious surfaces such as roofs and roads. This gave rise to more frequent flooding and in both cases, to flood alleviation schemes involving the enlargement of channel and culvert capacity.

The remainder of the area is predominantly rural but the expansion of existing towns and villages and individual developments could increase the flood risk to an unacceptable level if the watercourse that receives the runoff has insufficient capacity to cope with the extra flow. Our aim is to identify to the local planning authority these problems before they occur and either object to the development or request that compensation works are carried out in advance of the development. A good example of this was in the westward expansion of Saltash. Further development threatened to increase the existing flooding in Burraton Coombe and Forder to the west of Saltash. A scheme of flood storage, channel and culvert improvements was constructed which permitted certain developments to go ahead (see Section 4.7).

Development in some catchments gives us cause for concern and often results in us recommending refusal of planning permission. As examples the potential for flooding at Weston Mill in Plymouth means we will object to development in the Honicknowle area if it will add to surface water runoff. Similarly we object to development in parts of Plympton because of flooding on the Longbrook. Other areas such as Latchbrook in Saltash, Whitchurch near Tavistock, Tamerton Foliot and Millbrook have all had flood alleviation schemes built in the past whose design flood capacity must not be exceeded by allowing further runoff from new development.

Most development proposals in a watercourse such as culverting, bridging, sewer outfalls etc. require the formal consent of the Environment Agency under the Land Drainage or Water Resources Acts.

4.9 Mining and Quarrying

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

Areas of concern to the Environment Agency include:

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

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

Our Objectives

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

The Role of the Environment Agency

We have duties and powers to:

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

We are involved in a range of activities:

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

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Tamar Estuary and Tributaries Local Environment Agency Plan
Environment Agency

4.9.1 Local Perspective

There have been 240 mines identified in the catchment (see Map 14). Historically, the most important mining area was a 3 km wide band at the tidal limit of the River Tamar, embracing an extensive area of mineralisation extending into the Tavy and Lynher Catchments. Over 50 mines have been identified here, yielding copper, arsenic and pyrite and small deposits of tin, fluorite and wolfram. Other copper mining areas were north west of Mary Tavy in the Tavy Catchment and the Phoenix and Caradon Hill area in the Lynher Catchment. A cluster of fifteen mines located near Horrabridge were worked for copper. Lead and silver mines were worked on the Bere Peninsula and in the Tiddy Catchment, south of Pensilva.

Active Mineral Workings

Pomphlett and Moorcroft - Limestone and shale are quarried at this complex. A processing plant and a cement works are situated in the on-site factory complex. A recent planning application has been granted to alter the workings at Moorcroft Quarry. Due to various concerns, particularly the impact on groundwater and saline intrusion, a staged approach is being adopted. Permission is for working to a depth of 50 metres Below Ordnance Datum with ongoing monitoring to measure any impacts.

Lee Moor Complex - There are five china clay quarries in the Lee Moor area, operated by English China Clay International and Watts Blake & Beame. Clay is transported by pipelines to the various processing installations and is dried at either Marsh Mills or Headon.

Hemerdon Mine - Planning permission with stringent conditions on operation and development has been granted for opencast tungsten mining. The low price of tungsten on world markets has delayed economic working of the deposit.

New England Quarry - Mineral working for hard rock is only permitted west of the River Yealm. Extension to the east can only occur after stone reserves in the present area are worked out and a link bridge has been provided across the river.

Steer Point - Shale quarrying and operation of an on-site brickworks take place close to the River Yealm, Cofflete Creek and estuary-side woodlands of county wildlife significance.

Goldiggings and Darley Ford - Building stone and aggregates. Goldiggings works intermittently, reworking granite in existing waste tips. The impact of operations on this very sensitive area of great landscape, conservation and archaeological/historical importance will be carefully monitored by Cornwall County Council. Darley Ford Quarry is also in a sensitive area and its tipping and plant area are prominent within the AONB. Cornwall County Council will seek to negotiate additional measures to protect the environment.

Mill Hill and Hurdwick - Dimension Stone. Mill Hill will become exhausted before 2011. Hurdwick has not been worked since the 1930s but is an important source of local stone for the maintenance of historic buildings in Tavistock.

Map 15 - Quarrying



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Environment Agency

CATCHMENT USES

Merrivale, Higher Longford and Yennadon Quarries - Long established operations in Dartmoor National Park producing building, walling and ornamental stone. Machining of stone at Merrivale. Only Yennadon has comprehensive conditions on its permission.

The County Councils, in their Mineral Plans (Refs 24,25), propose investigation into the need and potential for establishing buffer zones between quarries and other sensitive uses.

Mineral Consultation Areas

Although there is no mineral working in the Tamar Valley at present the area has been identified as a Mineral Consultation Area because it is a nationally important metalliferous resource. However we have concerns that resumption of working could cause significant pollution.

There are small Minerals Consultation Areas around several old quarries on Bodmin Moor for stone and the lower Tamar Valley from Horsebridge to Calstock (metalliferous ores). In these areas the County Councils seek to control non-mineral development of a type that could lead to the inability to work mineral deposits or which by virtue of its siting or nature would not be compatible with mineral working or associated operations. Mineral Consultation Areas are also designated around the active mineral areas in the catchment, such as Lee Moor and Plymstock, as well as Hurdwick and Hemerdon Mine which have planning permission to extract but are not active, and Lyneham Wood which has no current permissions.

Mineral working in Dartmoor National Park

Within the National Park Prohibition Orders have been issued preventing resumption of working at Shaugh Bridge Clay Works, Shaugh Prior and Brisworthy Clay Works, and Cadover Bridge

Modification or suspension orders to secure environmental improvements and up-to-date conditions are in place at Higher Longford Quarry, near Tavistock An Interim Development Order (a permission that working cannot recommence until a scheme of working has been submitted and approved) exists for Pitts Cleave Quarry, near Tavistock.

Historic Mining Activity

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

An investigation into discharges in the Lower Tamar was undertaken by the National Rivers Authority in 1994. Several significant point and diffuse sources of dissolved copper were identified in the lower reaches of the River Tamar. (see Freshwater Tamar CMP, Ref 1)

Complementary work is being carried out by Caradon District Council to provide guidance on areas of potential instability and there is liaison to share information. Responsibility for the physical dangers posed by shafts and adits lies with the landowner, however, where there is public access and a perceived threat to public health the local authority may intervene.

CATCHMENT USES

Mining Impact on the Catchment

The presence of underground mine workings and drainage adits has significantly altered the local hydrology, concentrating groundwater flows along drainage adits, producing major discharge points. Any collapse or blockage within the mine system may alter flow paths, discharge points and quality of water. The shaft caps and internal mine structures are now reaching the end of their life and collapses have occurred, such as that at Michael's Shaft in Gunnislake.

The exact locations of many of the old shafts, adits and trial workings are not known. The historic mining areas from Kelly Bray to Calstock, the Tiddy Valley south of Pensilva and the Phoenix and Caradon area, have been identified by Caradon District Council as areas of Unstable (or potentially unstable) Land where any proposed development is subject to a Mining Search.

Elevated copper and zinc levels in various parts of the catchment are considered to arise from the drainage of old mines and adits and surface water from surrounding land. 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 may have an adverse impact on water quality (see Section 4.10, page 64).

China Clay

China clay production can affect water quality and water quantity, through discharge consents, pollution incidents, drawdown of water and direct abstractions. Discharge consents are the Environment Agency's means to control the effects of any discharges and these are being reviewed in stages. Currently they have been tightened to reflect existing performance. The next stage is to move to consents based on rivers needs (i.e. requirements of uses of the receiving waters).

A Code of Practice is being developed by the Environment Agency and china clay industry to promote good practice and eliminate some of the impacts and risks through management of sites. Routine meetings between the abstraction licence holders and the Environment Agency are required to ensure that currently held licences are understood by the licence holders and that we understand the complex pit operations.

Disposal of Mineral Waste

Control over the disposal and tipping of mineral waste lies with the Mineral Planning Authority and is addressed through appropriate planning conditions being put upon mineral workings. The Environment Agency does not licence mineral waste tips under waste regulations.

4.10 Contaminated Land

Contaminated land is defined as any land which appears to a local authority to be in such a condition, because of the substances it contains, that water pollution or significant harm is being, or is likely to be caused. This interpretation is subject to guidance yet to be issued by the Secretary of State under the new provisions of the Environment Act (1995). Some sites may be designated as 'special sites' and these will become the responsibility of the Environment Agency. None have yet been so defined. The process of identifying contaminated land across England and Wales is in its very early stages. The Department of the Environment is expected to carry out formal consultation on its draft contaminated land guidance between July and September 1996.

Derelict land is land which is considered to be so damaged by industrial or other developments that it is incapable of beneficial use without treatment. Such land includes for example, closed and disused waste tips or disused factory sites.

Our Objective

To prevent the pollution of ground and surface water or environmental harm arising from contaminated land.

The Role of the Environment Agency

Dealing with contaminated land is complicated. Often a lot of work has to be done to understand the problem fully. Before any action is taken we have to be sure that what is recommended (which can be very costly) will have worthwhile and lasting benefits. Some of the Environment Agency's priorities are given in the NRA's 'Contaminated Land and the Water Environment Report' (Ref 27) where we also describe some things we can do to tackle the problem. Planning authorities also have powers that they can use. We can:

- * comment on planning applications and give advice on the need for contaminated land assessment and design objectives for site remediation
- * advise local authorities when they undertake surveys to identify contaminated land
- * ensure that 'special sites' are dealt with in the most appropriate manner; left undisturbed, targeted for redevelopment or clean up plans prepared
- * take enforcement action if contaminated land is causing pollution
- * once the process of identifying sites is well underway we have a duty to prepare and publish a report on the state of contaminated land from time to time, or if specifically requested to do so by the Secretary of State.

The Environment Act 1995 provides a new legal framework for dealing with problems of contaminated land. Part II of the 1995 Act imports a new Part IIA into the Environmental Protection Act 1990.

Whilst the regulation of waste under Part II of the 1990 Act is the responsibility of the Environment Agency, primary responsibility for identifying and assessing contaminated land is placed on local authorities. Guidance will be given to these authorities by the Secretary of State for the Environment following consultation with the Environment Agency. The guidance will form the substance of this new legislation and will determine its effectiveness.

CATCHMENT USES

The powers to make regulations concerning the new system of liability for contaminated land were brought into force on 1 September 1995. The main provisions (the new Part IIA SS 78A-78YC) have yet to be introduced. Further details will be available in due course.

4.10.1 Local Perspective

Historic development within the catchment has left areas of contaminated land. Most contaminated areas are associated with mineral extraction and ancillary industries except in Plymouth where the city's naval and industrial past has left many sites in need of careful management.

Widespread and locally intense mining activity has led to impact on ground and surface water quality (See Section 4.9.2 and 5.1). Acidic metal rich mine waters result from weathering of sulphide and other minerals by oxygen rich rainwater draining into the mine systems. Similar contaminated drainage is associated with mine spoil dumps. Such dumps may also affect water quality by direct transport of contaminants into streams and rivers during wet weather conditions or following slippage of wastes on steep slopes.

Assessment of impact and risks to local water interests may show any of the following mitigation measures to be necessary:

- minimisation of ground disturbance,
- avoidance of soakaways in mine waste materials,
- seal the surface and other measures to limit rainwater infiltration,
- removal of mine wastes to an appropriately licensed landfill site,
- avoidance of direct discharge down mine shafts,
- encouragement of plant cover to stabilise mine spoil dumps, and
- treatment of mine discharge waters.

Contaminated land in urban areas arises from escape of pollutants from a wide range of land uses. Heavy bombing of the industrial areas during the Second World War has left many pockets of contaminated land or river sediments throughout the city. Comprehensive data sources on land affected is not currently available although some preliminary work has been undertaken by Caradon District Council. The most extensive areas known to be affected by contaminative land uses, including power generation, fuel distribution and storage, chemical manufacture, shipbuilding and breaking, quaysides etc. are within Plymouth, particularly alongside the estuary, for example at Cattedown and Devonport Dockyard. Other potentially contaminative land uses, including industrial estates, gas works sites, petrol stations and dry cleaners are more widespread.

Contaminated Sediments

Contamination of the sediments of Plymouth Sound and its adjoining estuaries is widespread but variable in degree. Before the undertaking of any activity likely to disturb and mobilize the sediments in this area the Environment Agency would require the nature and severity of contamination to be established such that appropriate mitigating measures could be taken. Ministry of Agriculture Fisheries and Food have an interest in activities requiring Food and Environmental Protection Act licences, particularly those where disposal of sediment to sea was proposed.

CATCHMENT USES

Objective 43 (page 22) in the Tamar Estuaries Management Plan (Ref 7) raises the need for increased understanding and consideration of the effects of disturbing contaminated sediments through development.

Some Local Examples

Salt Mill

Caradon District Council has prepared a Planning Brief for the Salt Mill area at Saltash which will permit schemes including 15.9 ha of marina on this semi-derelict area of former tip. The Environment Agency has concerns over the development of the site as our observations have detected a black sludge on the shoreline emanating from the site. Any development that is going to disturb the ground or sediments would require a detailed investigation that will satisfy our concerns and show that proposals will not threaten the quality of any controlled waters.

Drakewalls Mine

The Gunnislake area has many sites where metalliferous mining has left a legacy of contaminated land (see Section 4.9, Mining and Quarrying). One of the largest is Drakewalls Mine where Caradon District Council have prepared a Planning Brief. Some parts of the site are so hazardous that the filling, landscaping and fencing to provide areas for nature conservation is the only option available.

Hooe Lake

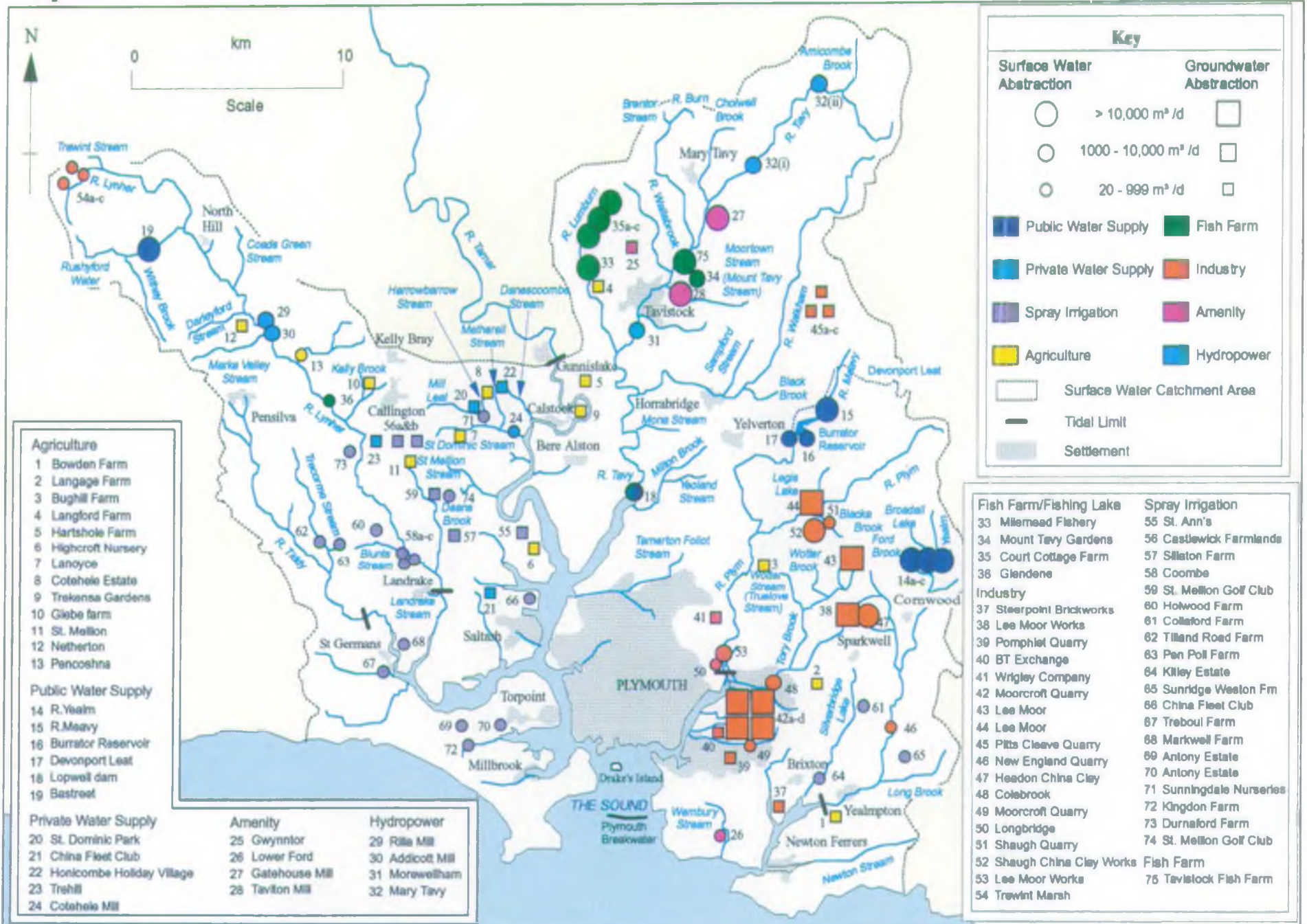
The sediments in this area are contaminated with heavy metal and organic pollutants. Any disturbance of these contaminated sediments that will result in a dispersal into the water column may cause a deterioration in water quality and impact on plants and wildlife. Mitigation measures and controlled working practices are necessary in any clearance or development work in this area.

Chelson Meadow is discussed in Section 4.13, Waste Management.

Millbrook

The site at Southdown has been used for a variety of industrial uses over 300 years. This has left 'hotspots' of contamination that were identified as part of an environmental assessment to accompany a planning application for a residential and marina redevelopment. Any redevelopment will require a fuller contaminated land assessment and mitigation proposals.

Map 16 - Abstraction



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4.11 Abstraction and Water Supply

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

Our Objective

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

The Role of the Environment Agency

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

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

Environment Agency Policies & Activities

We have adopted a range of key policies in order to fulfill our statutory duties. Foremost amongst these are:

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

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

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

Map 17 - Water Resources For Public Water Supply



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4.11.1 Local Perspective

In the catchment there are currently 73 licensed surface water and 322 licensed groundwater abstractions. The authorized annual total of water which can be abstracted from the catchment is 226,359 Megalitres/year (Ml/y), 222,445 Ml from surface waters and 3,914 Ml from groundwater sources (1Ml = 1 million litres). These authorized totals reflect the hydrogeology of the catchment, which is characterized by rocks with very limited groundwater storage (see Section 3.1). As a result there is a large dependence upon abstraction from surface sources, namely rivers and reservoirs.

On average, the total resource available from the catchment is approximately 641,000 Ml/year. The authorized gross total of water which can be abstracted from the catchment (226,359 Ml/year) amounts to 35% of the available resource, though this is a distortion of resource consumption since some is returned to the catchment after use. At the catchment scale the available resource far exceeds the nett abstracted quantity, but at the local level this loss can be significant. At some locations individual abstractions may impact on river flows to a significant level. These "low flow sites" are discussed further in Section 5.2.2.

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

Public Water Supply

Public water supplies in the catchment are provided by South West Water (SWW). Supplies to the largest demand centre, the city of Plymouth, are met from abstractions within the plan area and from Roadford Reservoir (see Map 17). Roadford, the centrepiece of SWW Roadford strategic supply system is located on the River Wolf, a tributary of the River Tamar. It releases water for subsequent abstraction at Gunnislake. Water from Gunnislake can be either transferred to Crownhill Water Treatment Works (WTW) for use in the city or transferred across the catchment to Littlehempston WTW near Totnes for use in the Torbay area. Water is also transferred into the catchment from Colliford and Siblyback Reservoirs to meet demand in Saltash and Torpoint.

SWW hold 7 public water supply licences for abstraction within the catchment with an annual authorized volume of 78,844 Ml/year. Of these 6 are from surface water. Only one, Wheal Lucky Adit (in the River Walkham Catchment), is from groundwater.

The number of public water supply licences and the total annual authorized licence quantity on each river catchment is shown in Table 12. The locations of the sources are shown on Map 17 and the details of each licence are summarised in Appendix F.

Map 17 shows the movement of public water supply within and outside the catchment. There is a 9.1 Ml/d abstraction on the Withey Brook at Bastreet. Water from the Withey Brook, including transfers from Siblyback reservoir (in the Colliford Strategic Supply Zone) is abstracted at Bastreet to meet demand in the Launceston area.

The other 6 abstractions are in the Roadford Strategic Supply Zone. The river abstraction on the Tavy at Lopwell is the largest. Under the abstraction licence 50% of any excess flow above the prescribed flow of 0.845m³/sec can be abstracted up to maximum of 91 Ml/d and 33,215 Ml/year.

CATCHMENT USES

Burrator on the River Meavy is the only water company reservoir in the catchment. It has a net capacity of 4,210 Ml and supports a maximum abstraction of 90.9 Ml/d and 29,549 Ml/year. Water from both Lopwell and Burrator is transferred to Crownhill Water Treatment Works for supply to Plymouth. Water from Burrator can also be used to support local demand via Dousland WTW.

Dousland WTW also receives water imported to the Meavy from the headwaters of the West Dart catchment via the Devonport Leat. When the flow in the leat exceeds the demand at Dousland the excess spills into Burrator Reservoir.

The abstractions at Lopwell and Burrator are an important part of SWW Roadford strategic supply system which also includes two other reservoirs, Roadford and Meldon (not shown on map) and three other river abstractions. Together all of these abstractions provide supplies of water to Plymouth, the South Hams and Torbay, as well as North Devon and parts of North East Cornwall.

Non Public Water Supply licensed abstractions (see Table 12)

Fish Farming

There are 6 licences for fish farms (see Section 4.6) and for fishing lake abstraction in the catchment of which 4 are on the River Tavy. The largest, Tavistock Fish Farm, is authorised to abstract 22.7 Ml/d and 8294 Ml/year. Flow is diverted into the farm at a natural bend in the river about 2.5 km downstream of Mary Tavy. The water returns to the River Tavy just upstream of Wallabrook and Evan's Weir. During periods of low flows and when there are no releases from Mary Tavy Power Station a large proportion of the available flow is abstracted leaving a deprived stretch of about 60 metres between the offtake and the confluence with the River Burn.

Hydropower

There are 7 licences for hydropower in the catchment, 3 on the River Lynher, 3 on the River Tavy and 1 on the tidal Tamar. Although all of these abstractions are non-consumptive they reduce river flows between the abstraction and discharge points. The largest abstractions are on the River Tavy where National Power are licenced to abstract a total of 156.4 Ml/d and 38642 Ml/year for Mary Tavy Power Station and 106.4 Ml/d and 36368 Ml/year for Morwellham Power Station (shown separately in Table 12).

The abstractions for Mary Tavy Power Station take place at Tavy Cleave and Hillbridge. Old mine leats have been used to transfer water to two small reservoirs (Wheal Jewel and Bennetts) from where it is conveyed by pipe to the power station and then back to the Tavy via Cholwell Brook. Usually water is released from the reservoirs over a 12 hour period beginning at 7 am. Typically this released water (pulse) takes about 2.5 hours to reach Tavistock and 10 - 11 hours to reach Lopwell. At Lopwell the pulse is reduced by the Tavistock - Morwellham Canal abstraction and extended slightly due to increases in channel storage. (See Fig II, page 10). Water is being continuously abstracted. When water is released from the reservoirs only the 7.5 km stretch of the river to Mary Tavy Power station is deprived of flow. When not, river flows downstream of Mary Tavy are impacted by the abstractions.

National Power also abstract at Abbey Weir in Tavistock from where water is transferred via the Tavistock - Morwellham Canal to Morwellham power station before being released to the River Tamar downstream of the tidal limit. The abstraction represents a total loss to the River Tavy.

CATCHMENT USES

In addition in 1978, an Agreement was made between the then South West Water Authority and the Central Electricity Generating Board (now National Power) to control the level of abstraction into the Tavistock - Morwellham Canal by setting a series of prescribed flows at Abbey Weir, Tavistock. The Agreement stated that the prescribed flow should be raised from 54.5 ML/d to 147.7 ML/d in six steps over the years 1981 to 2011.

The impacts of National Power abstractions, Tavistock Fish Farm and SWWS Lopwell abstraction are currently subject to a detailed investigation. (See Section 5.2).

Table 12: Nett private licensed resource commitment in the Tamar Estuary and Tributaries Catchment

Abstraction Purpose	Ground Or Surface Water	Number Of Licensed Uses ¹	Authorized Quantity (ML/year)	Proportion Of Abstraction Not Returned	Net Resource Commitment (ML/year) ²
Agriculture (excl. spray irrigation)	Ground	243	439.9	25%	110.0
	Surface	10	14.7		3.7
Spray Irrigation	Ground	10	34.8	100%	34.8
	Surface	21	166.2		166.2
Fish Farming	Ground	0	0	0%	0
	Surface	6 ³	12251.8		0
Industry	Ground	11	3163.2	30%	949.0
	Surface	12	7474.9		2242.5
Hydropower	Ground	1	17.6	0%	0
	Surface	4	46891.4		0
National Power Leats	Ground	0	0	0%	0
	Surface	2	75009.7		0
Other Private Water Supply	Ground	56	136.0	25%	34.0
	Surface	12	1915.6		478.9

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

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

3. Four fishing lakes (distinct from fish farm in 4.6) also hold licences.

Map 18 - South West Water Services Limited Consents



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4.12 Effluent Disposal

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

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

Our Objective

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

The Role of the Environment Agency

We have duties and powers to:

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

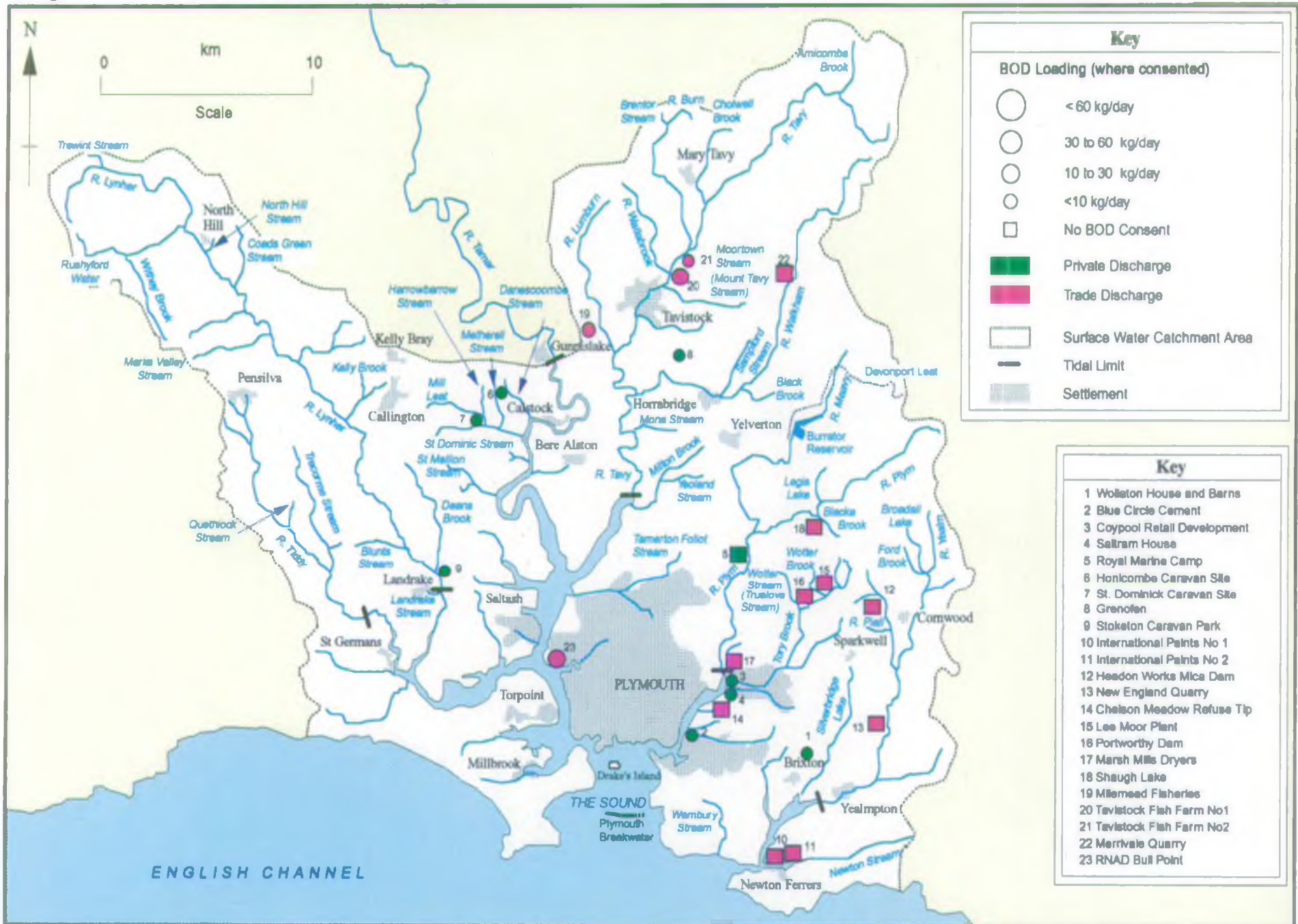
We are involved in a range of activities:

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

Improvements to South West Water (SWW) Discharges

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

Map 19 - Private and Trade Discharges



CATCHMENT USES

In order of priority, schemes included are:

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

OFWAT declared the associated customer charging base in July 1994. This was subsequently reviewed by the Monopolies and mergers Commission at SWW request. We have agreed a programme and timetable for improvement schemes in the catchment and these are shown in Section 5.1 We are currently negotiating a programme for improvements to intermittent discharges with SWW.

4.12.1 Local Perspective

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

There are two types of consented discharges :

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

These are either discharges to ground or surface waters.

Continuous Discharges

Within the catchment there are 54 SWW sewage treatment works (see Map 18) of which 14 are small works which receive no trade effluent and have descriptive consents, where no numerical quality standards are imposed.

There are 9 consented private sewage treatment works, (see Map 19), none of which is of significant volume.

The past, current and projected proportion of population on mains sewerage systems are given in Table 13.

CATCHMENT USES

Table 13: Percentage of population on mains sewerage

	% of population on mains sewerage		Forecasts of % population connected to mains sewerage					
			2001		2011		2021	
Catchment	1989	1992	Low	High	Low	High	Low	High
Tamar Estuary	89.0	88.1	88.9	89.3	92.0	90.4	90.7	91.3
Tavy	83.9	82.6	85.3	84.4	85.5	85.4	86.0	86.1
Plym	82.7	78.2	87.4	86.6	86.9	89.7	88.2	90.2
Yealm	76.4	75.0	78.1	79.2	80.4	81.0	83.1	83.1
Plymouth	99.0	99.0	98.8	98.8	98.8	98.8	99.2	98.9
Lynher & Tiddy	74.5	72.3	75.7	78.4	77.8	80.0	79.8	82.7

(Source: SWW, Forward Planning Dept.).

Table 13 shows there are, and will continue to be, a significant proportion of private discharges particularly in the more rural parts of the catchment. Our National policy is to discourage the proliferation of small private treatment plants in favour of mains connections. We will refuse consent applications where people on mains sewerage wish to change to private discharges.

There are currently 10 Environment Agency recommended areas of development restraint in the catchment (see Section 4.7) for water quality reasons. This is where sewage treatment works (STWs) are not complying with their consents, where discharges have an environmental impact on receiving waters, or are causing EC Directive failure. Development restraints are requests by the Environment Agency to planning authorities to prevent development which would require connections to mains sewerage systems where this would make an existing problem worse.

Industry

There are 14 consented trade discharges in the catchment, see Map 19.

The following locations failed discharge consent assessment for the year to December 1995:

Lee Mill Industrial Estate STW
Coypool Retail Development
St Dominick Caravan Site
Portworthy Dam (CP 38/3)
Tavistock Fish Farm A and B

Marsh Mills STW
Saltram House
Grenofen Manor*
Marsh Mills Dryers
Merrivale Quarry

Grenofen Council House
Honicombe Caravan Site
Lee Moor Plant(CP38/6)
Stoketon Caravan Park

* This consent has subsequently been reviewed and is now below 5m³/day

Deemed Consents

There are approximately 105 deemed consents within the catchment, most of which discharge to the estuary or tidal waters. Due to their number they have not been mapped in this document.

CATCHMENT USES

These are historic consents (covering usually basic effluent systems or crude discharges) where funds have not been available to ensure improvements. Many will have to make improvements to comply with EC Directive compliance dates. In advance of this the Environment Agency is involved in negotiating improvements for each of the discharges, and much progress has already been made. The most significant number of deemed consents (45) are held by the Ministry of Defence (MoD) or Devonport Dockyard. The MoD has elected to make improvements although there is no statutory requirement on them to do so. Many of these will be picked up in the Plymouth Central Scheme.

Intermittent Discharges

There are numerous intermittent discharges in the catchment, for example storm sewer overflows. Most are not known to cause significant problems. However, the River Tavy is affected by the operation of storm sewer overflows, See Section 5.1.

Pollution Events

Table 14: Pollution incidents arising from industrial and sewage effluents 1992 to 1994.

Pollution Incidents	Major	Significant	Minor
Industrial			
1992	0	4	23
1993	0	2	24
1994	0	1	31*
Waste Water Treatment			
1992	0	1	71
1993	0	2	63
1994	0	1	59

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

* The slight increase shown in industrial minor incidents was due to operational problems at landfill sites. Enforcement measures have been taken and remediation works are fully underway.

Sewerage Improvements

Improvements to various sewage systems and treatment works are planned in the next few years by SWW in their AMP2 investment programme. The reasons for these changes and expected benefits are given in Section 5.1.

Plymouth Streams Report

In 1995 the NRA undertook an assessment of the quality of a number of streams in the Plymouth urbanised area. A few stretches have been identified as having water quality problems. Drainage in these areas will be inspected and improvements will be brought about in conjunction with Plymouth City Council and SWW.

CATCHMENT USES

Poor water quality in urban watercourses can arise from a variety of factors including misconnections and general household waste. Although the survey did not highlight a significant problem, at some locations, such as Forder Valley Stream and Hartley Stream which flow into Plymouth City Council Nature Reserves, effects have been noticed by the City Conservation Officer. Concerns are particularly focussed on the inputs from misconnections or illegal connections from private properties to the surface water sewers, principally introducing detergents from washing machines.

Further work needs to be undertaken to properly assess the current state of the watercourses and the level of any impact (see page 123). In view of the lack of historic records invertebrate and macrophyte surveys could be carried out. These organisms can act as a long term indicator of changes. Any additional information held by other groups and individuals would also be useful.

If there is shown to be a problem, a campaign to raise the awareness of householders and pursue remedial measures could be undertaken. This has been done in Bristol in a collaborative project between Bristol City Council, Wessex Water and the Environment Agency. There may however be significant costs involved.

4.13 Waste Management

The management of controlled wastes may include storage, treatment, processing or disposal facilities. Each type of operation may impact on the catchment but landfill disposal in particular can result in the formation of a highly polluting liquid known as leachate, or landfill gas containing methane, which is potentially dangerous and also a 'greenhouse gas'. Leachate is produced as wastes break down and decompose and the quantity is multiplied by any ingress of water into the waste. Any escape of this pollutant from a landfill site would have a serious impact on the catchment as leachate can pollute surface and ground waters. Operation of waste sites can also generate noise, dust, odour and unsightliness, and vehicle movement may cause a highway nuisance. It is therefore important that the potential impact on the proposed locations for new facilities is given careful consideration.

Previously when a new waste facility was planned, planning permission was sought from the Planning Authority and a Waste Management Licence was applied for from the Waste Regulation Authority. The Authorities then routinely referred the applications to the NRA for comment. The merging of NRA/Waste Regulation functions into the Environment Agency on 1 April 1996 enables a more coordinated input into the planning and licensing systems to ensure that environmental interests are given proper consideration.

The NRA previously published its views on landfill in its 'Position Statement on Landfill and the Water Environment' (Ref 28). In this statement the concepts of waste minimisation and recycling are stressed. These concepts have been further stressed in the Government White Paper 'Making Waste Work' (Ref 29) which sets out the draft Government strategy for the sustainable management of waste. The Environment Agency will itself be forming a Regional Waste Strategy based on the recommendations of the White Paper.

Some wastes are spread on farm-land to improve the soil. If this is not done in accordance with current codes of practice however, there is a potential for the waste to cause pollution to water and harm to wildlife. This activity is exempted from formal waste management licensing but is subject to a pre-notification and registration system with the Environment Agency which monitors such activities to ensure protection of the environment.

Our Objective

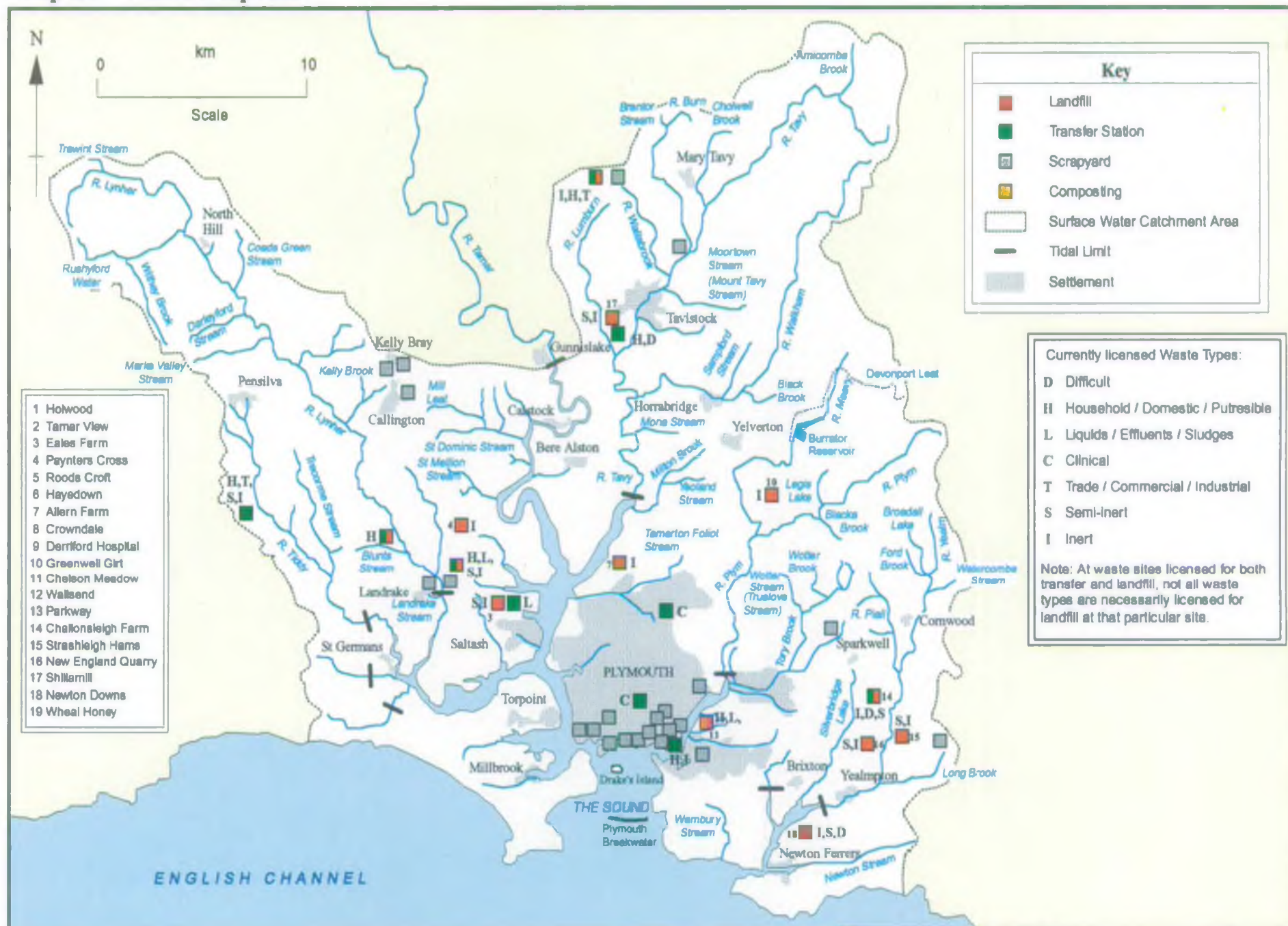
To prevent environmental pollution through the management of wastes.

The Role of the Environment Agency

We have duties and powers to:

- * Licence waste management sites
- * Ensure that new facilities have minimal adverse environmental impact by including conditions of operation within Waste Management Licences.
- * Ensure that site operators make plans to monitor for changes in the quality of ground and surface waters and for the presence of landfill gas in and outside of landfills.
- * Ensure that sites are maintained and operated properly by means of regular inspections
- * Take enforcement action to prevent or control pollution occurring from a licensed site or where waste has been handled or disposed of illegally.

Map 20 - Waste Disposal



Information correct as of November 1995

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Tamar Estuary and Tributaries Local Environment Agency Plan
Environment Agency

CATCHMENT USES

Our work involves a range of activities:

- * We work with planning authorities to make sure that new waste handling and disposal facilities are not located where they would cause pollution of water by offering appropriate comments on statutory Structure Plans and Waste Local Plans.
- * In commenting on individual proposals we recommend appropriate operational methods and engineering works to be incorporated which minimise risk of pollution.
- * We work to ensure that no new facilities have an adverse impact on important habitats and species, or the historic environment.
- * We ensure protection of groundwaters through the Groundwater Protection Policy²⁰

4.13.1 Local Perspective

There are two active landfill sites in the catchment accepting domestic and other putrescible wastes: Holwood Quarry and Chelson Meadow.

Holwood Quarry Landfill, operated by County Environmental Services, is situated 6 km south of Callington. The site occupies a disused road stone quarry excavated into the north east side of a steep valley and is underlain by Upper Devonian Slates. Holwood Quarry has no engineered basal liner and therefore operates on 'dilute and disperse' principles, where leachate within the wastes is allowed to drain into the underlying natural rock. However, a significant percentage of leachate generated by the wastes is presently collected within the site and irrigated onto approximately 8 acres of nearby broad leaved woodland (rather than being allowed to drain through the base of the site). The leachate produced is considered to be relatively weak and investigations for Cornwall County Council have shown its application to be of benefit to the soil. The site will be filled to final levels in approximately 1997, however leachate irrigation is expected to continue into the next century until all biodegradation processes have ceased.

Chelson Meadow is situated 1.5 km north west of Plymstock immediately adjacent to the River Plym. The site is divided into two sections, the northern section which is full and being restored for possible after use as a golf course, and the southern section which is still being used for tipping. It is currently operated by Devon Waste Management, but until this company is vested, ultimate responsibility for the site still rests with Devon County Council. The site has been operational for over twenty years and is situated on estuarine alluvium overlying Devonian Slates and locally Devonian Limestone. Natural containment offered by the alluvium is locally absent at the eastern end of the site. The site has historically been used to dispose of domestic, industrial, special and difficult wastes. The site has passive leachate collection systems within the waste drain to a new treatment plant prior to discharge to the River Plym. There have been historic problems with leachate containing tributyle tin (TBT) entering the Plym Estuary.

Other than the River Plym, the site is also bounded by two leats, one to the north and one to the south of the current landfill. Detailed proposals to prevent pollution of the northern leat have been agreed between the operators and the Environment Agency. Waste disposal operations are continuing in the southern half of the site and we are continuing to comment on all proposed works at the site and any amendments to the site licence working plan to ensure both ground and surface waters are protected. We are also continuing to monitor the risks of leachate migration from the site into Moorcroft Quarry (Section 4.9) immediately to the south of the site.

CATCHMENT USES

At current levels of use it is estimated that Chelson Meadow will become full by the year 2002. In line with government policy and in order to extend the life of the site Plymouth City Council and Devon County Council are looking at ways to reduce the city's reliance on landfill by diverting up to 75% of its waste to recycling. Tenders for alternatives are due in July 1996. Pilot schemes are operating in some areas of the city to collect recyclable materials at source. Additional measures such as composting and incineration are also being considered.

Devon County has a rapidly decreasing landfill capacity, a situation which will be compounded by the closure of Exeter's incinerator this year. This problem is being discussed by a working party of representatives from the County Council, the ten District Councils and the Environment Agency, who between them are preparing a strategy for the future management of Devon's waste. A draft document for Cornwall is due for consultation in September 1996. In Addition the Environment Agency will be formulating a regional strategy following a waste survey which will begin this year, see Section 5.5.

One other site, now closed, is recorded within the catchment as having historically accepted significant volumes of domestic wastes. Crowndale Landfill site lies to the south west of Tavistock adjacent to the River Tavy. The site is underlain by river alluvium including gravel deposits, which in turn overlies fissured slates. The alluvial and gravel deposits are locally highly permeable. The proximity of the River Tavy to the landfill site makes the river particularly vulnerable to pollution by any breakouts of leachate, and recent monitoring of the Tavy indicates that leachate may be bypassing the existing collection systems and polluting the river, see Water Quality, page 100.

Responsibility for the site is held by Devon County Council (DCC), who have proposed possible options for remediation of the site such that future contamination of surface and groundwaters is reduced to acceptable levels. We are liaising with DCC concerning the implementation of the proposed works.

In addition to the three major landfills above there are six sites licensed to accept Category B semi-inert wastes and five sites licensed to landfill Category A inert wastes including Roodscroft, situated 4 km north west of Saltash and is underlain by Upper Devonian slates. A planning application to landfill Category B wastes was refused and later dismissed at appeal (March 1995) due to the site's proximity to ecologically sensitive locations. Also at Roodscroft is a licensed transfer station where a variety of incoming wastes, particularly construction and demolition wastes, are sorted and bulked to facilitate materials recycling.

Ten licensed sites are used as transfer sites for waste handling operations. There are also twenty three scrapyards operating in the catchment. There are twenty eight closed sites within the catchment, of which five are recorded as having accepted putrescible wastes. These sites are often located in former small quarry workings, which due to the geological setting, are widespread in the catchment.

As a major population centre Plymouth and outlying towns produce large amounts of waste for handling. Disposal now and in the future will be an issue, see 5.5, page 146.

4.14 Controlled Processes

Controlled Processes authorisation provides a vehicle for the delivery of environmental commitments which Government makes on behalf of the nation.

The Role of the Environment Agency

The Environment Agency is the statutory authority in England and Wales for regulating the largest and most complex industrial processes which discharge harmful non-radioactive and radioactive waste to air, water and land. To do this we use a system known as Integrated Pollution Control (IPC). Operators of these controlled processes are required to have an authorisation to discharge waste. The Agency also regulates the release of radioactive substances.

We have duties and powers to:

- * regulate processes and stipulate minimum technical specifications for processes following principles of Best Available Technology Not Entailing Excessive Cost (BATNEEC) whilst having regard to the Best Practicable Environmental Option (BPEO)
- * review authorisations every four years.

Two lists of processes have been prescribed by regulations for control:

Part A processes are potentially the most polluting processes and releases to air, water and land are controlled under Integrated Pollution Control (IPC) by the Agency

Part B processes are potentially less polluting and releases to air from Part B processes are controlled at a local level under a system of Local Authority Air Pollution Control. The Environment Agency may be involved with releases to water and land

Part A and Part B processes are defined in The Environmental Protection (Prescribed Processes and Substances) Regulations (Ref 45).

We also have a responsibility to supervise and regulate the spreading of waste on agricultural land.

Our work involves a range of activities:

- * we liaise with Planning Authorities to advise on the impact of potential Part A processes on the environment and the effect on proposed development adjacent to Part A processes.
- * we liaise with SWW over the discharge of prescribed substances to foul sewers and authorise the discharge to controlled waters.
- * we regularly inspect and monitor prescribed processes to ensure that they comply with the Authorisation.

Integrated Pollution Control (IPC)

Authorisations are issued under Section 6 of the Environmental Protection Act 1990 to operate a particular manufacturing process. The authorisation comprises:

- Part 1 operation of process, records and other matters
- Part 2 releases to air
- Part 3 releases to water
- Part 4 other releases
- Part 5 improvement programme

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Part 6 interpretation

Schedules 1&2 sampling points and forms.

and is subject to the express conditions set out in Parts 1 to 6. Aspects of the process not regulated by those conditions are subject to a general condition implied by Section 7(4) of the 1990 Act that the person carrying it on must use best available techniques not entailing excessive costs;

- a for preventing the release of substances prescribed for any environmental medium into that medium or, where that is not practicable by such means, for reducing the release of such substances which are so released; and
- b for rendering harmless any other substances which might cause harm if released into any environmental medium.

Techniques include (in addition to technical means and technology) the number, qualifications, training and supervision of persons employed in the process and the design, construction, layout and maintenance of the buildings in which the process is carried on. Further information on IPC can be found in the Environment Agency's document 'Charging Scheme for Integrated Pollution Control' (Ref 46).

4.14.1 Local Perspective

The controlled processes in the catchment are shown in Table 15.

Table 15: Controlled Processes in Tamar Estuaries and Tributaries Catchment

Operator	Type of Permissions	Legislation covering regulation
Blue Circle Cement	IPC	Cement manufacture. IPC authorisation under Environmental Protection Act 1990
Marine Projects (Plymouth) Ltd	IPC	Organic solvent recovery process. IPC authorisation under Environmental Protection Act 1990
Stafford Miller, Plymouth	Water	Determination under Water Industry Act 1991
Devonport Dockyard	RAS2, RAS3, RAS4	Registrations and authorisations under Radioactive Substances Act 1993
Derriford Hospital	RAS3, RAS4	Registrations and authorisations under Radioactive Substances Act 1993
Haul Waste, Derriford	RAS3	Authorisations under Radioactive Substances Act 1993
Freedom Fields Hospital	RAS3, RAS4	Registrations and authorisations under Radioactive Substances Act 1993
University of Plymouth	RAS3	Registrations and authorisations under Radioactive Substances Act 1993

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Operator	Type of Permissions	Legislation covering regulation
Plymouth Marine Laboratory	RAS3, RAS4	Registrations and authorisations under Radioactive Substances Act 1993

Note: RAS2 denotes a nuclear site, subject to licensing under Section 1 of the Nuclear Installations Act 1965 (such as Devonport Dockyard) and RAS3 authorisation or RAS4 registration denote a non-nuclear site (for example a hospital). The Environment Agency publication 'Charging Scheme for Radioactive Substances Act Regulations 1996-97' gives further details (Ref 47). There are also a further 22 RAS4 licences in the catchment.

Information is made available to the public via the public register, annual reports and an annual Chemical Release Inventory (CRI). Statutory monitoring information is also held on the public register. The confidentiality of some processes and discharge information can significantly affect the commercial interests of a company if they were made public. We have discretion to withhold such information. Some Government sites, such as Ministry of Defence sites, can also be exempt from the register.

Radioactive Substances

The Environment Agency is the principal regulator in England and Wales under the Radioactive Substances Act 1993. This statute is concerned with the storage, use and disposal of radioactive substances, and in particular, the regulation of radioactive waste. Each site is assessed by the Agency and permission granted on the basis that the use of radioactive substances is justified and that operators are prepared to abide by conditions to safeguard human health and protect the environment. The permissions take the form of:

- certificates of registration for keeping and using radioactive materials; and,
- certificates of authorisation for the accumulation and disposal of radioactive waste.

Devonport Dockyard

Her Majesty's Naval Base at Devonport has performed a role for the Ministry of Defence in supporting the Royal Navy's nuclear powered submarine fleet since the early 1970s. The submarines require regular maintenance and during these maintenance periods solid and liquid radioactive waste arisings can occur. Disposal of these wastes is controlled by means of Certificates of Approval granted on the same terms as for sites with nuclear site licences which are regulated under the Radioactive Substances Act 1993.

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TARGETS & STATE OF THE CATCHMENT

5.0 TARGETS AND STATE OF THE CATCHMENT

5.1 Water Quality

We aim to maintain and where appropriate improve the quality of water for all those who use it.

We achieve this by setting water quality targets for the catchment based on:

- River Quality Objectives to protect recognised uses
- standards laid down in EC Directives
- international commitments to reduce the amount of Annex 1A substances entering tidal waters.

In this chapter, we report on the state of the catchment by comparing existing water quality with relevant water quality targets. We have identified issues where targets are not being achieved and action is needed to improve water quality. We have also identified other water quality issues in the catchment.

River Quality Objectives

The water quality targets that we use in all rivers are known as River Quality Objectives (RQOs). RQOs are used for managing water quality and are based on the River Ecosystem (RE) classification scheme. The River Ecosystem scheme is made up of five water quality classes (RE1 to RE5) (Appendix C). These classes reflect the chemical quality needed by different types of river ecosystem including the types of fishery they can support. The RE classification scheme replaces the National Water Council (NWC) system that was used by the NRA until the end of 1993.

Table 16: Translation of River Quality Objectives based on the NWC scheme to River Ecosystem Classes

Old RQO (NWC Scheme)	New RQO (RE Class)
1A	RE1
1B	RE2
2	RE3/RE4
3	RE5
4	RE5

How RQOs will be set

Wherever possible we set new RQOs that reflect historical RQOs based on the NWC system (see Table 16). We can set RQOs that are higher than the historical RQOs, and in certain circumstances we have to set RQOs that are lower than the historical RQOs.

All RQOs must be achievable and sustainable. This means we that we must be able to identify what needs to be done to meet the RQO. We must also be able to ensure, as far as is practicable to do so, that water quality can be maintained at this level in the future.

We set RQOs based on the need to protect current water quality and future use. We also take into account available investment to improve water quality, including, for example through South West Water's AMP2 investment programme agreed with Government (see Section 4.12, Effluent Disposal).

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Unlike the historical RQOs based on the NWC system which had no date for achievement, the new RQOs must be achieved by a certain date within the next 5 to 10 years.

Setting Long Term RQOs

We will set long term RQOs under the following circumstances:

Sometimes we are unable to set RQOs that reflect the historical RQOs based on the NWC system. This is because there are no resources available to ensure that the RQO is achievable or sustainable within the next 5 to 10 years. In these cases we will set a long term RQO equivalent to the historical RQO.

In some river stretches we know that water quality can be improved to a level better than the historical RQO based on the NWC system, for example by improving effluent discharges. However, there may not be the necessary resources available in the next 5 to 10 years to make these improvements. Therefore, we will set a long term RQO better than the historical RQO.

We will use these long term RQOs as a basis for setting consents for new discharges and planning for future water quality improvements.

Achievability of Historical RQOs based on the NWC System

In some cases the historical RQOs based on the NWC scheme are unachievable, for example where major land use changes would be required to improve water quality. In these cases we will set RQOs that reflect current water quality to ensure that water quality in these stretches does not deteriorate. This will also ensure that resources to improve water quality are targeted at those parts of the catchment where water quality can be improved to protect river uses.

"Set Aside" of Data

In certain circumstances we can "set aside data", that is we will not take into account some or all the results for a particular determinand when we assess compliance with an RQO.

Reduced pH and Elevated Zinc and Copper Concentrations

We "set aside" data where high concentrations of metals or low pH values are caused by the natural geology of the catchment. This allows us to protect good water quality shown by other determinands in the RE classification.

We have published a manual 'Water Quality Objectives: Procedures used by the National Rivers Authority for the purpose of the Surface Waters (River Ecosystem) (Classification) Regulations 1994', which describes how data may be 'set aside'.

Those stretches where data has been set aside are identified in Table 17 and Map 21.

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Table 17: Stretches where data has been 'set aside'

River	Stretch	Data Set Aside
Yealm	Source - Hele Cross	pH
Plym	Source - Shaugh Bridge (3 stretches)	pH
Tory Brook	Source - Portworthy Bridge (2 stretches)	pH
Wotter Brook	Source - Tory Brook confluence	pH
Meavy	Source - Weir above Burrator Reservoir	pH
Meavy	Burrator Reservoir - Below Burrator Reservoir	pH, Zinc
Meavy	Below Burrator Reservoir - Plym confluence (2 stretches)	Zinc
Tavy	Source - Hill Bridge	pH
Walkham	Source - Ward Bridge (2 stretches)	pH
Cholwell Brook	Source - Tavy confluence	Copper, Zinc
Lynher	Rilla Mill Bridge - Bicton Mill Bridge	Copper
Withey Brook	Source - U/S Bastreet Water Treatment Works Intake	pH, Copper

Proposals for RQOs and long term RQOs for the Tamar Estuary Catchment

The RQOs based on the RE classification that we are proposing for the catchment are shown on Map 21. These proposed RQOs must be complied with from 1996 unless a later date is shown next to the class for example: RE2 (1998), an RQO of RE Class 2 must be achieved from 1 January 1998. The proposed RQOs are equivalent to the historical RQOs based on the NWC system unless stated below.

There are ten stretches in the catchment where we are proposing RQOs which are higher than the historical RQO which are shown in Table 18.

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Table 18: Proposed RQOs which are higher than historical RQOs based on the NWC system

River	Stretch	RQO (NWC)	Proposed RQO(RE)
River Yealm	Yealm Bridge to Above Yealmpton STW	1B	RE1
River Piall	Quick Bridge - Yealm confluence	2	RE1
Tory Brook	Source - Tolchmoor Bridge	2	RE1
	Tolchmoor Bridge - Portworthy Bridge	2	RE1
	Portworthy Bridge - Normal Tidal Limit	2	RE2
River Tavy	Source - Hill Bridge	1B	RE1
	Below Crowndale STW - Shillamill	2	RE2
	Denham Bridge - Normal Tidal Limit	1B	RE1
River Walkham	Magpie Bridge - Tavy confluence	1B	RE1
Cholwell Brook	Source - Tavy confluence	1B	RE1

There are two stretches in the catchment where we are proposing RQOs which are lower than the historical RQO, which are shown in Table 19. This table also shows the stretch, marked *, where we are proposing a long term RQO equivalent to the historical RQO:

Table 19: Proposed RQOs which are lower than historical RQOs based on the NWC system

River	Stretch	RQO (NWC)	Proposed RQO(RE)
Tamerton Foliot Stream	Source - Normal Tidal Limit	1A	RE2
Kelly Brook	Haye - Lynher Confluence*	2	RE5 [3]

From Table 19 it can be seen that for the Tamerton Foliot Stream we are proposing a RQO/long term RQO which is lower than the historical RQO. This stream is subject to irregular pollutions arising from urban runoff. Although work is ongoing between the Environment Agency and Plymouth City Council quality in this watercourse has never achieved a level better than the proposed RQO and it would be difficult to achieve an RQO of RE1 given the urban-type area.

Table 20 shows where we are proposing long-term RQOs for the following river stretches that we would like to achieve but for which there are currently no resources to make improvements. These are also shown on Map 21, for example [RE2] indicates that a long term RQO of RE2 applies in that stretch.

TARGETS & STATE OF THE CATCHMENT

Table 20: Proposed long term RQOs for the Tamar Estuary Catchment

River	Stretch	RQO (NWC)	Proposed long term RQO(RE)	Reason for Proposing long term RQO
River Yealm	Above Yealmpton STW - Below Yealmpton STW	1B	RE1	To protect salmonid fishery
	Below Yealmpton STW - the Normal Tidal Limit	1B	RE1	
Newton Stream	Source - Normal Tidal Limit	1B	RE1	Stretch contains STW which needs funding to sustain current water quality
Silverbridge Lake	Source - Normal Tidal Limit	1B	RE1	
River Lumburn	Source - Rushford Bridge	1B	RE1	To protect salmonid fishery
	Rushford Bridge -Tavy confluence	1B	RE1	
River Lynher	Berriowbridge - Rilla Mill bridge	1B	RE1	Water quality is better than RQO of RE2 but investment at an STW is required to ensure that this is sustained
River Tavy	Harford Bridge to Kelly School	1B	RE1	To protect salmonid fishery
	West Bridge - Below Crowndale STW	2	RE2	
	Below Crowndale STW - Wash Ford	1B	RE1	
Kelly Brook	Haye to Lynher confluence	2	RE3	To ensure Callington STW receives investment to improve downstream water quality

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State of the Catchment

Compliance with RQOs and Long Term RQOs

Map 21 also shows where current water quality fails to meet its proposed RQO. This assessment is based on three years of routine monitoring data from the Public Register collected between 1992 and 1994. We have shown failures to meet RQO as "significant" and "marginal" failures. Significant failures are those where we are 95% certain that the river stretch has failed to meet its RQO. Marginal Failures are those where we are between 50% and 95% certain that the stretch has failed to meet its RQO.

Of the 92 monitored river stretches (209.2 km) in the catchment there are no stretches which significantly fail to meet their RQO, and 3 stretches (11.5 km of river) which marginally fail to meet their RQO. The reasons for these failures are explained below.

We have also assessed whether river stretches meet their long term RQO, and the reasons for failures to meet the long term RQOs are explained below.

River Yealm

A stretch of the River Yealm from Below Ridgect Lake to Popple's Bridge marginally fails to comply with the RQO of RE 1 due to elevated levels of Biochemical Oxygen Demand. This could be caused by effluent from Lee Mill Industrial Estate STW and surface runoff from the industrial estate. The STW intermittently fails its consent and we are now taking enforcement action to ensure compliance.

Issue 1: Effect of STWs on water quality.

Water quality in two stretches of the River Yealm from above Yealmpton STW to the Normal Tidal Limit does not meet with the long term RQOs of RE 1 due to elevated levels of Biochemical Oxygen Demand. The source(s) have not been identified, but there have been problems in the past with storm overflows and agricultural runoff.

Issue 2: Unknown sources of BOD affecting water quality.

River Meavy

Two stretches of the River Meavy from below Burrator Reservoir to the Plym confluence marginally failed to comply with their RQO of RE 1 due to elevated levels of Biochemical Oxygen Demand. The monitoring data shows that non-compliance in both stretches was caused by a single high result, the cause of which is unknown. We will continue to monitor this watercourse and in the event of further failures, we will take action to identify the source.

River Tavy

Water quality in the stretch of the River Tavy from Harford Bridge to Kelly School does not meet the long term RQO of RE 1 due to elevated levels of Biochemical Oxygen Demand. The source(s) have not been identified. Investigations are continuing to identify sources.

See Issue 2

Water quality in the stretch of the River Tavy from West Bridge to Below Crowndale STW does not meet the long term RQO of RE 2 due to elevated levels of Biochemical Oxygen Demand and total ammonia. The two principal causes are suspected to be effluent and stormwater from Crowndale STW and the operation of storm sewer overflows within Tavistock. Although no expenditure has been identified for the improvement of Crowndale STW, SWW are planning to improve Storm Sewer Overflows (SSOs) in Tavistock which have been shown to be causing

TARGETS & STATE OF THE CATCHMENT

aesthetic pollution in the River Tavy and may also contribute to reduced water quality.

See also Issue 1, Issue 3: Effect of storm sewer overflows on water quality.

River Lynher

Water quality in the stretch Berriowbridge to Rilla Mill Bridge is consistently better than the proposed RQO. However, this stretch receives several STWs discharges which could downgrade water quality. As there is no further investment planned it is considered that this water quality is not yet sustainable and a long term RQO has been set.

Kelly Brook

Water quality in the Kelly Brook does not meet with the long term RQO of RE 3 due to elevated levels of Biochemical Oxygen Demand, total ammonia and unionised ammonia caused by effluent from Callington STW. We are currently negotiating with South West Water for improvements to be carried out at this STW.

See Issue 1.

EC Directives

There are six EC Directives that currently apply to the catchment. The designated stretches and sites are shown on Maps 22 & 23. Additionally there are parts of the catchment which are proposed as a Special Area of Conservation under the EU Habitats Directive. This may have implications for future water quality targets (see Sections 4.1 and 5.3).

Derogations

Where EC Directives standards (EC Freshwater Fish and EC Surface Water Abstraction Directives), in particular those for metals and/or pH are not met due to natural sources, we can apply for a derogation. This means that we will continue to monitor and report concentrations of derogated substances. However, the derogation acknowledges that although we understand why these substances exceed their standards we cannot control their release into the environment.

EC Bathing Waters Directive (76/160/EEC)

The Bathing Waters Directive 'concerning the quality of bathing water' (76/160/EEC) protects the environment and the health of bathers using identified bathing waters by reducing pollution entering identified bathing areas. The Directive contains standards for nineteen microbiological, physical and chemical parameters to assess bathing water quality. Compliance is assessed mainly by standards for total and faecal coliforms which are bacteria that occur in sewage and other faecal matter.

We are responsible for monitoring the quality of identified, popular bathing waters and providing the results to DoE who decide whether the standards in the Directive have been met. Where identified bathing waters fail to meet the Directive, we are responsible for identifying sources of pollution that are causing failures, and making sure that improvements are made.

State of the Catchment

There are five identified EC Bathing Waters in the catchment (Map 23). These and their compliance are shown in Table 21.

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Table 21: Compliance with EC Bathing Water Directive

Name	Compliance									
	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Wembury Beach	FAIL	FAIL						FAIL		
Bovisand Beach								FAIL		
Plymouth Hoe (East)	FAIL	FAIL	FAIL		FAIL	FAIL	FAIL	FAIL	FAIL	
Plymouth Hoe (West)	FAIL	FAIL	FAIL		FAIL	FAIL	FAIL	FAIL	FAIL	
Portwrinkle Beach		FAIL								

The EC Bathing Water at Wembury failed to comply with the Directive in 1986, 1987 and 1993. An NRA investigation has shown that flushing of surface water drains by rainwater after a dry period is the principal source of bacteria to bathing waters at Wembury. In addition there may be diffuse and point source agricultural inputs entering via the Wembury Stream. This is likely to remain a problem in the future. Operation of the emergency overflow at Wembury pumping station could also have an impact on bacterial levels, due to its close proximity to the beach. A new type of sewage treatment has been introduced at Wembury STW, and the impact on bathing water quality will be monitored.

The EC Bathing Water at Bovisand failed to comply with the Directive in 1993. The principal source of bacteria to bathing waters at Bovisand is from the Bovisand Stream. If there are failures at Bovisand in the future the Environment Agency will undertake an investigation to identify the causes.

The EC Bathing Waters at Plymouth Hoe East and West failed to comply with the Directive in all years except 1989 and 1995. The cause of the failure is crude sewage discharges in the vicinity of this bathing water. Improvements to these discharges will be carried out by SWW as part of the Plymouth Central Clean Sweep Scheme, due to be completed in 1998. A number of existing crude discharges will transfer to a new STW where they will receive secondary treatment and UV disinfection.

The EC Bathing Water at Portwrinkle failed to comply with the Directive in 1987. The principal source of bacteria to bathing waters at Portwrinkle was the discharge of crude sewage from the Portwrinkle outfall. In 1994 SWW completed a scheme to provide secondary treatment and extend the outfall. This should ensure future compliance with the EC Bathing Water Directive.

Issue 4: Non-compliance with EC Bathing Water Directive standards at Wembury and Plymouth Hoe East and West.

EC Dangerous Substances Directive 76/464/EEC

The Dangerous Substances Directive 'on pollution caused by certain substances discharged in the aquatic environment of the community' (76/464/EEC) protects the water environment by controlling discharges that contain harmful substances to rivers, estuaries and coastal waters.

This Directive describes two lists of compounds. List I contains substances regarded as particularly dangerous because they are toxic, they persist in the environment and they bioaccumulate.

TARGETS & STATE OF THE CATCHMENT

Discharges containing List I substances must be controlled by Environmental Quality Standards (EQSs) issued through Daughter Directives (Appendix C). List II contains substances which are considered to be less dangerous but which can still have a harmful affect on the water environment. Discharges of List II substances are controlled by EQSs set by the individual Member States.

We are responsible for authorizing, limiting and monitoring dangerous substances in discharges. We are also responsible for monitoring the quality of waters which receive discharges containing Dangerous Substances and reporting the results to DoE who decide whether the standards in the Directive have been met. Where the requirements of this Directive are not met, we are responsible for identifying sources of pollution and making sure that improvements are made.

State of the Catchment

List I substances are monitored in the receiving waters of five discharges in the catchment (Maps 22 & 23). These are shown in Table 22.

Table 22: Sites monitored for List I substances

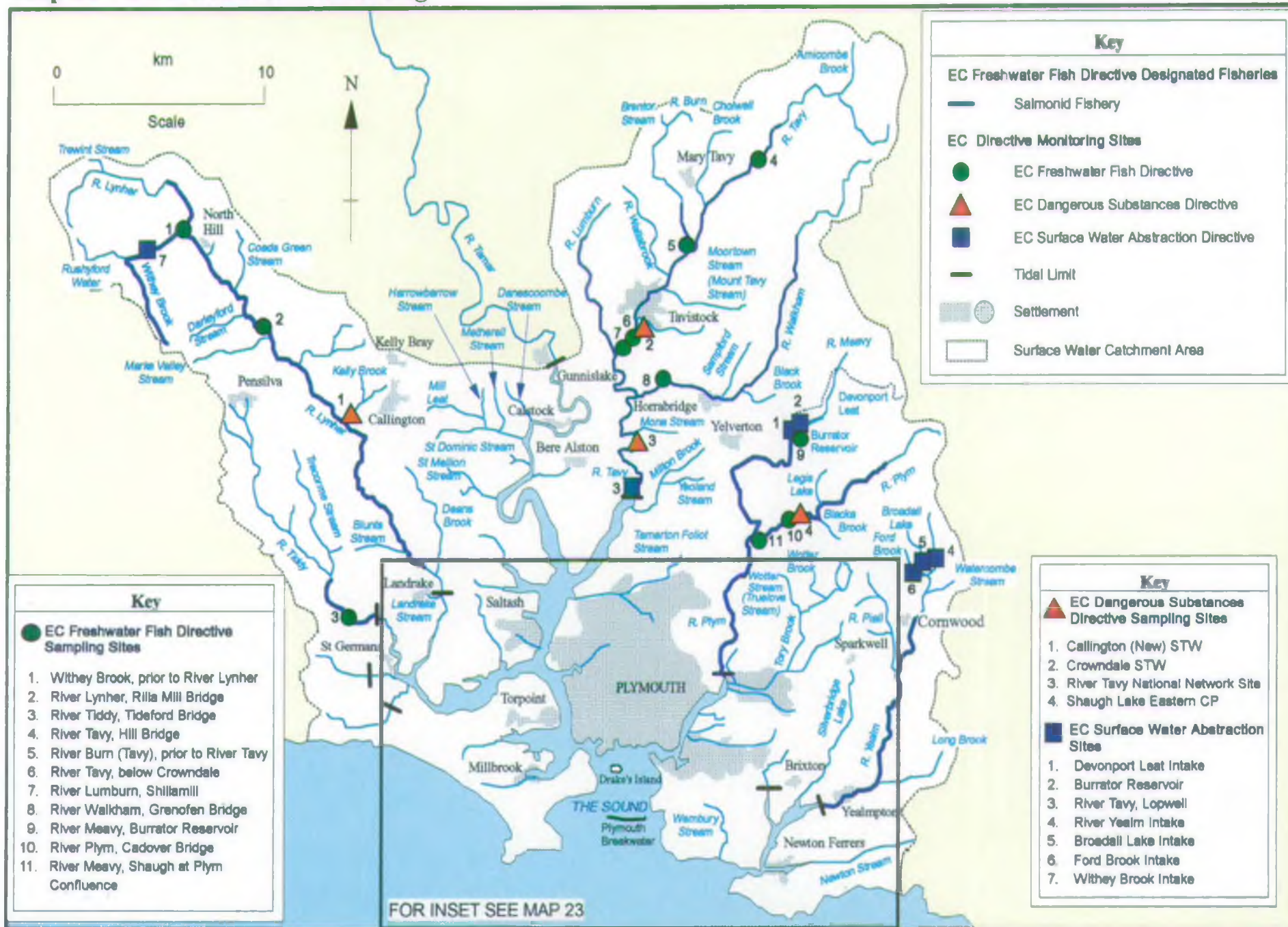
Site	Substance(s) monitored
Yealmpton STW	Cadmium
Callington STW	HCH
Crowndale STW	HCH
Marsh Mills STW	Cadmium, HCH
Saltash (Coombe) STW	Cadmium

There have been no Environmental Quality Standard exceedances in the receiving waters of these sites in the period 1992 to 1994.

Increases in cadmium concentrations have been recorded in sediment downstream of Yealmpton STW in 1993 and 1994. However, the increases have not resulted in the Environmental Quality Standard being exceeded in the water column, therefore no immediate action is required. We will continue to monitor the site.

There are twenty discharges whose receiving waters are monitored for List II substances in the catchment. These are shown in Table 23.

Map 22 - EC Directives Monitoring



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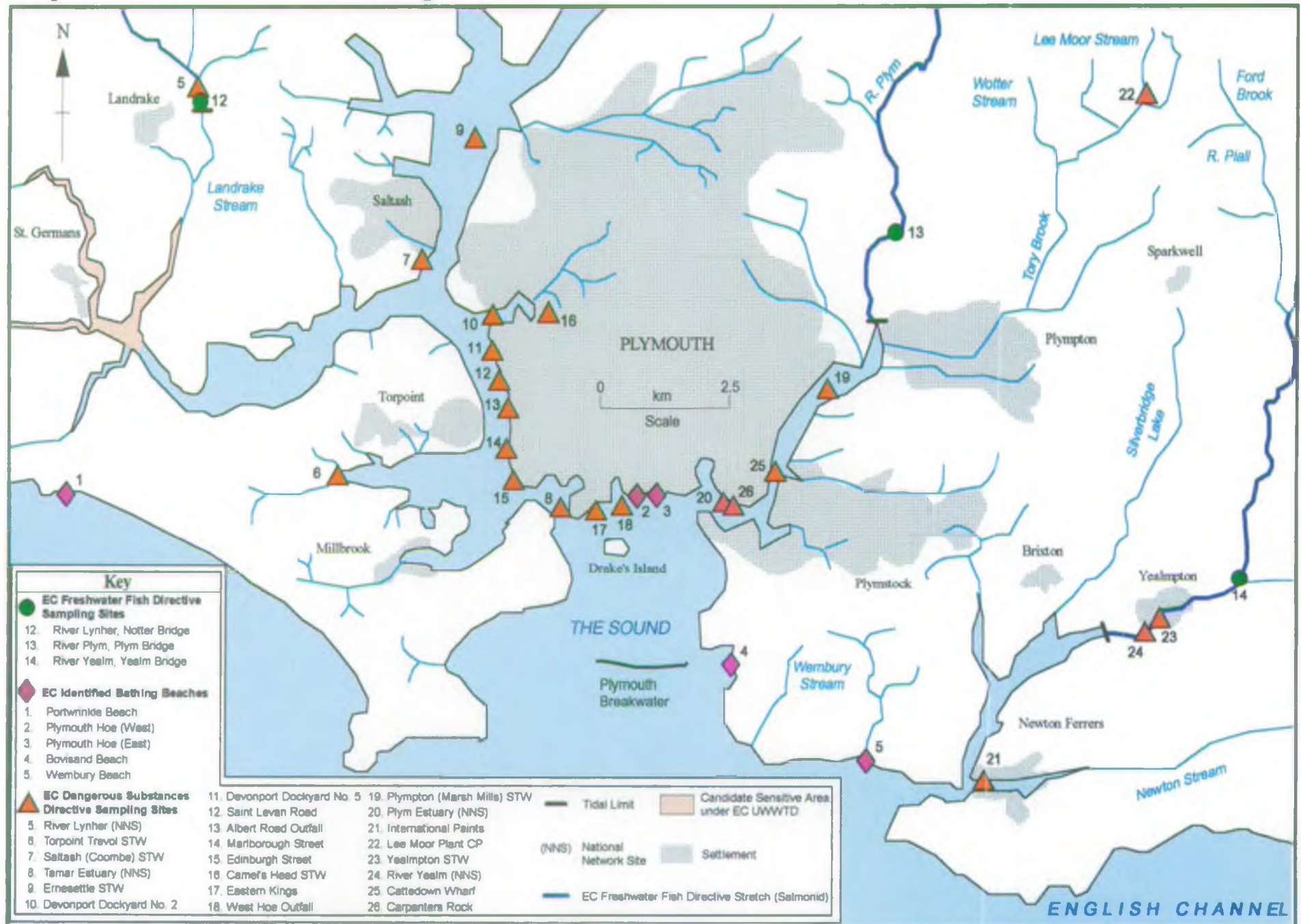
Table 23: Sites monitored for List II substances

Discharge	Failing Determinand	Year EQS exceeded
Lee Moor Plant CP 38/6	pH (lower) Zinc	1995, 1994, 1993, 1992 1995
Shaugh Lake Eastern CP	pH (lower)	1995, 1994, 1993, 1992
Crowndale STW	Copper, zinc	1995
Yealmpton STW	none	
International Paints	Tributyltin Copper	1995, 1994 1995
Torpoint Treval STW	none	
Saltash (Coombe) STW	none	
Albert Road	none	
Camel's Head STW	none	
Carpenters Rock	none	
Cattedown Wharf	none	
Eastern Kings	none	
Edinburgh Street	none	
Ernesettle STW	Copper	1995
Marlborough Street	none	
St Levan Road	none	
West Hoe	Nickel	1992
Marsh Mills STW	none	
Devonport Dockyard No.2	none	
Devonport Dockyard No.5	none	

There was an Environmental Quality Standard exceedance for tributyltin (TBT) in the receiving waters at International Paints in 1994 and 1995. There are four possible causes of this exceedance. The first is the discharge from International Paints. The second is the use of TBT-based antifouling paints on boats greater than 25m in length, the third is the illegal use of TBT-based antifouling paints on boats <25 m in length and the fourth is the suspension of TBT contaminated sediments and/or the desorption of TBT from sediments. There was an Environmental Quality Standard exceedance for copper in 1995. We will be carrying out further investigations.

Issue 5: Exceedance of EQS for tributyltin and copper in the River Yealm downstream of the discharge from International Paints.

Map 23 - EC Directives Monitoring



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There was an Environmental Quality Standard exceedance for pH in the receiving waters at both Lee Moor Plant Control Point and Shaugh Lake Eastern Control Point for the period 1992 to 1995. Low pH is a naturally occurring problem in many areas of the South West, and we are currently discussing with Environment Agency Head Office whether the derogation of pH is appropriate at these sites. There was also an Environmental Quality Standard exceedance for zinc at Lee Moor Plant CP in 1995. Elevated zinc levels can also be due to natural causes, exacerbated by historic mining activities. Further investigation is required to determine the extent to which geology and china clay discharges contribute to low pH and elevated zinc levels.

Issue 6: Low pH and elevated zinc concentrations downstream of china clay works.

There were Environmental Quality Standard exceedances for copper and zinc in 1995 in the receiving water downstream of Crowndale STW. The cause is unknown and investigations will be undertaken.

There was an Environmental Quality Standard exceedance for copper in 1995 in the receiving water downstream of Ernesettle STW. The cause is unknown and investigations will be undertaken.

Issue 7: Exceedence of copper and zinc Environmental Quality Standards downstream of Crowndale and Ernesettle STWs.

In 1996 we will start monitoring a new site, in the Hamoaze off Devonport Dockyard in Plymouth, for tributyltin under the EC Dangerous Substances Directive.

EC Freshwater Fish Directive 78/659/EEC

The Freshwater Fish Directive 'on the quality of waters needing protection or improvement in order to support fish life' (78/659/EEC) ensures that water quality in designated stretches of water is suitable for supporting certain types of fish.

This Directive contains two sets of quality standards. One set of standards protects cyprinid or coarse fish populations. The other set of standards that are stricter, protects salmonid fish populations, for example, salmon and trout.

There are two sets of standards for each fishery type: imperative standards, which must be achieved, and guideline standards that Member States should aim to achieve.

We are responsible for monitoring the quality of identified fisheries and reporting the results to DoE who decide whether the standards in the Directive have been met. Where the requirements of this Directive are not met, we are responsible for identifying sources of pollution and making sure that improvements are made.

State of the Catchment

Stretches of the Rivers Yealm, Plym, Meavy, Walkham, Lumburn, Lynher, Tiddy, Tavy, Burn (Tavy) and Withey Brook have been designated as salmonid fishery (Map 22). Derogations have been applied to some of these stretches, which are shown in Table 24.

TARGETS & STATE OF THE CATCHMENT

Table 24: Designated salmonid stretches with derogations

Stretch	Determinand(s)	Year
Plym: Ditsworthy - Normal Tidal Limit (2 stretches)	pH	1992, 1993, 1995
Tavy: Willsworthy - Hill Bridge	pH	1993, 1995
Lynher: Rilla Mill - Normal Tidal Limit	Zinc	1992, 1993, 1995
Burn (Tavy): Mary Tavy Bridge - Tavy confluence	Zinc	1993, 1995

The imperative standards of the EC Freshwater Fish Directive have been exceeded at only one site in the catchment in the period 1992 to 1995. In 1993 and 1994 the monitoring site Below Crowndale STW on the River Tavy failed to meet the imperative standard for total ammonia. An investigation by the NRA found the principal cause of failure to be Crowndale STW and storm sewer overflows in Tavistock. Leachate from Crowndale Tip was also found to be entering the River Tavy. Although this has a localised impact we do not consider it contributes to the exceedance of Directive standards.

See Issue 1.

EC Urban Wastewater Treatment Directive (UWWTD) 91/271/EEC

The EC Directive 'concerning urban wastewater treatment' (91/271/EEC) specifies minimum standards for sewage treatment and sewage collection systems.

This Directive specifies secondary treatment for all discharges serving population equivalents greater than 2,000 to inland waters and estuaries, and greater than 10,000 to coastal waters. Discharges below these population equivalents receive "appropriate" treatment as defined in the AMP2 guidance note (Ref 30).

We are responsible for making sure that discharges receive the level of treatment specified in this Directive.

This Directive also allows higher standards of treatment for discharges to *sensitive* areas. *Sensitive* areas are those waters which receive discharges serving population equivalents of greater than 10,000, and are or may become eutrophic in the near future.

We carry out monitoring to find out whether a watercourse is a sensitive area. We present this information to DoE who decide whether the watercourse is sensitive. We then ensure that discharges to the sensitive area receive a higher level of treatment.

State of the Catchment

There are 3 UWWTD schemes, and 9 appropriate treatment schemes in the catchment. Details of the schemes are shown in Table 25.

TARGETS & STATE OF THE CATCHMENT

Table 25: UWWTD schemes in the Tamar Estuary Catchment

Scheme	Treatment Level	Investment Driver	Statutory Completion Date
<u>TIDAL WATERS</u>			
Saltash STW	secondary	UWWTD	2000
Ernesettle STW	secondary	UWWTD	2000
Calstock STW	secondary, outfall relocation and nitrification	UWWTD and to protect passage of Migratory Fish	2005
Bere Ferrers	primary	UWWTD (appropriate treatment)	2005
Cawsands (Criterion)	secondary	UWWTD (appropriate treatment)	2005
Cawsands (South)	secondary	UWWTD (appropriate treatment)	2005
Kingsands (North)	secondary	UWWTD (appropriate treatment)	2005
Kingsands (South)	secondary	UWWTD (appropriate treatment)	2005
Cremyll	fine screening	UWWTD (appropriate treatment)	2005
St. Dominick	secondary	UWWTD (appropriate treatment)	2005
<u>FRESHWATER</u>			
Landrake	secondary	UWWTD (appropriate treatment)	2005
Mary Tavy	secondary	UWWTD (appropriate treatment)	2005

We have identified the Lynher Estuary as a candidate sensitive area. It has one indirect qualifying discharge, Callington STW (see Issue 1) . We are carrying out monitoring to determine whether the Lynher Estuary is eutrophic, and to identify the principle sources of nutrients to the estuary (see also Trophic status, page 110).

Issue 8: Determine whether the Lynher Estuary is a sensitive area under the UWWTD.

EC Surface Water Abstraction Directive 75/440/EEC

The Directive 'concerning the quality required of surface water intended for the abstraction of drinking water in the Member States' (75/440/EEC), protects the quality of surface water used for public supply. This Directive ensures that water abstracted for public supply meets certain quality standards and is given adequate treatment before entering public water supplies.

TARGETS & STATE OF THE CATCHMENT

The Directive sets out imperative standards that must be achieved, and guideline standards that Member States should aim to achieve, for water for public supply which is to be given different levels of treatment.

We are responsible for monitoring the quality of designated surface water abstractions and reporting the results to DoE who decide whether the standards in the Directive have been met. Where standards are not met, we are responsible for identifying sources of pollution and making sure that improvements are made.

State of the Catchment

There are six identified surface water abstraction points in the catchment. The results of monitoring are shown in Table 26 below.

Table 26: Failure to meet EC Surface Water Abstraction Directive standards.

Site	Reason for Failure
River Yealm Intake	Colouration: 1992, 1993, 1994, 1995 Total phenols: 1993, 1994 D&E Hydrocarbons: 1992, 1993, 1994, 1995
Broadall Lake Intake	Colouration: 1992, 1993, 1994, 1995 Total phenols: 1993, 1994 D&E Hydrocarbons: 1992, 1993, 1994, 1995
Ford Brook	Colouration: 1992 Total phenols: 1992, 1993, 1994 D&E Hydrocarbons: 1992, 1993, 1994, 1995
Burrator Reservoir	Colouration: 1993 Total phenols: 1993, 1994 D&E Hydrocarbons: 1994, 1995 Dissolved Iron: 1994, 1995
Devonport Leat Intake at Dousland	Colouration: 1993, 1994 Total phenols: 1993, 1994 D&E Hydrocarbons: 1994, 1995
River Tavy at Lopwell	D&E Hydrocarbons: 1994

Derogations for colouration have been applied since 1993 at four of the sites: River Yealm Intake, Broadall Lake Intake, Burrator Reservoir and Devonport Leat Intake. These sites have naturally occurring high colouration caused by humic acids in the peaty moorland soils.

In 1992 Ford Brook exceeded the standards for coloration. This was due to natural causes and no action was taken.

In 1994 and 1995 Burrator Reservoir exceeded the standards for dissolved iron. This was due to local geology. The Environment Agency will apply for a derogation.

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Five of the six sites exceeded the standards for phenols and/or dissolved (D) and emulsified (E) hydrocarbons (D&E hydrocarbons) in the period 1992 to 1995. The Environment Agency is concerned about the suitability of the methods for analysis of phenols and D & E hydrocarbons as specified in the EC Surface Water Abstraction Directive. Exceedances of the Directive's standards cannot always be attributed to polluting discharges, and we suspect that some exceedances may be due to natural compounds resulting from the breakdown of vegetation. We are involved in discussions with the Department of Environment, with a view to reviewing the analytical methods used. We will continue to report exceedances of the EC Surface Water Abstraction Directive standards. However, as there are no obvious sources of these compounds in the catchment we are not planning to undertake any further studies until we receive direction from the DoE.

In 1996 we will start monitoring a new site on the Withey Brook, a tributary of the River Lynher, under the Surface Water Abstraction Directive.

EC Shellfish Hygiene Directive

The Shellfish Hygiene Directive 'laying down the health conditions for the production and the placing on the market of live bivalve molluscs', (91/492/EC) protects the health of consumers of live bivalve molluscs such as mussels and oysters. This Directive defines standards for shellfish quality required in the end product. It also classifies bivalve mollusc shellfish harvesting areas into four categories according to the concentrations of bacteria found in the shellfish flesh (Appendix C).

The Ministry of Agriculture, Fisheries and Food (MAFF) and the Department of Health (DoH) share responsibility for this Directive in England and Wales. We have only a minor role in implementing this Directive. Although we provide information on the location of discharges that may affect harvesting areas, we cannot require that improvements are made to polluting discharges under this Directive. However we can use our powers to ensure that water quality does not deteriorate in harvesting areas.

State of the Catchment

There are four sites in the catchment which are classified as bivalve mollusc production areas by the Directive. These are shown in Table 27 below.

Table 27: Sites monitored under the Shellfish Hygiene Directive

Production Area	Bed Name	Species	Class
Yealm	Upper and Lower	<i>Crassostrea gigas</i>	B
Plymouth	Lynher	<i>Ostrea edulis</i>	B
	Lynher	Mussels	C
	Tamar-below Saltash Bridge	<i>O. edulis</i> and Mussels	C
	Whitsand Bay	Mussels	B

TARGETS & STATE OF THE CATCHMENT

Shellfish harvested from category B areas must be depurated, heat treated or relaid to meet category A before consumption. Shellfish harvested from category C must be relaid for long periods (2 months) to meet category A or B before consumption (they may also be heat treated by an approved method).

Other International Commitments

Annex 1A Reduction Programme

At the second and third North Sea Conferences in 1987 and 1990, the UK Government made a commitment to reduce the load (load = concentration x flow) of certain harmful substances, known as Annex 1A substances (see Appendix C), entering tidal waters from rivers and direct discharges. Loads of most Annex 1A substances were to have been reduced by 50 %, but loads of mercury, cadmium and lead by 70 %. Reductions were to have been achieved by 1995 compared to a 1985 baseline, or a 1991/1992 baseline where data for 1985 was unavailable. These reductions had not been fully achieved by the time of the fourth North Sea Conference in 1995, however it was agreed that the reduction targets should be met as soon as possible.

We are responsible for monitoring and identifying significant sources of Annex 1A substances. We identify significant sources by ranking loads of Annex 1A substances, in rivers and direct discharges, according to their size. A discharge is significant if it belongs to the group of discharges that contribute to the first 95 % of the total load entering tidal waters. In accordance with DoE guidelines we identify where reductions can be made.

State of the Catchment

Six sites are monitored for Annex 1A purposes in the catchment. These are shown in Table 28. Additionally the estuary receives inputs from the River Tamar. These were dealt with in the Freshwater Tamar and Tributaries Catchment Management Plan (Ref 7).

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Table 28: Sites monitored for Annex 1A purposes in the Tamar Estuary Catchment.

Site	Substance	Year significant
Radford STW	parathion	1993
Marsh Mills STW	nickel	1992
Camel's Head STW	parathion	1993
Ernesettle STW	endrin	1992
Lopwell Dam, River Tavy	copper zinc lead arsenic	1991, 1992, 1993 1993 1992, 1993 1991, 1992, 1993
Notter Bridge, River Lynher	copper zinc lead nickel arsenic dichlorvos	1991, 1992, 1993 1991, 1992, 1993 1992 1992 1991, 1992, 1993 1993

Radford and Camel's Head STWs were significant sites for parathion in 1993. Parathion is an organophosphorous compound used as an insecticide and an acaricide. The monitoring data for Annex 1A in 1993 shows that at both sites there is only one positive result for parathion, indicating these are isolated incidents. Products containing parathion are not registered with MAFF or the Health and Safety Executive for use in the UK. However a recent NRA report, 'Pesticides in the Aquatic Environment', shows that parathion has been found in both fresh and saline waters in the UK.

Ernesettle STW was a significant site for endrin in 1992. Endrin is a persistent organochlorine insecticide with a high acute toxicity, and has been banned from use since 1984. The data for Ernesettle STW shows there were only two positive results in 1992.

The River Lynher at Notter Bridge was a significant site for dichlorvos in 1993. Dichlorvos is an organophosphate compound with a wide range of uses as an insecticide and anthelmintic. Annex 1A data for this site shows that only one positive result was recorded in 1993. This would seem to indicate that this is an isolated incident. As products containing dichlorvos are widely available then it is expected that such incidents will occur, for example, through careless disposal.

Marsh Mills STW was a significant site for nickel in 1992. Although the load of nickel was significant as measured under Annex 1A (this includes a measurement of flow), the Plym Estuary meets the EQS for dissolved nickel concentrations under the EC Dangerous Substances Directive (see page 95).

Map 24 - Biological Classification 1994



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During the period 1990 to 1993 significant amounts of copper, lead, zinc and arsenic were found at Lopwell Dam (River Tavy) and significant amounts of copper, zinc, lead, nickel and arsenic were found at Notter Bridge (River Lynher). The high recorded loads of metals, particularly copper and arsenic, can be attributed to the Rivers Tavy and Lynher passing through old mining areas.

Following the 4th ministerial conference on the North Sea (June 1995) we are awaiting guidance from DoE to determine what further action we must take to reduce loads.

5.1.3 Additional Monitoring

As well as the work we carry out to meet the requirements of RQOs, EC Directives and other international commitments, we carry out additional monitoring. This additional monitoring helps us to determine the state of water quality in the catchment.

Consent assessment failures

As reported in section 4.12 there were a number of dischargers which failed consent assessment in the year to June 1995. It is standard Environment Agency practice to encourage and work with dischargers to identify the causes of failure and make improvements to prevent a reoccurrence. Investigations usually can place the failure into one of three categories:

- works with suitable infrastructure but improved management needed
- inappropriate consent
- cause not definitely identified.

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

Brixton STW discharges into a section of freshwater, immediately above the Yealm Estuary. It has a Deemed Consent, and as such is not measured against any water quality parameters. The works has secondary treatment but produces a poor quality effluent and there have been reports that discharges sometimes contain aesthetically unpleasant material. Investigation may be required to establish the occurrence of aesthetic pollution, but it is a works in which we would like to see improvement, though no funding has been allocated in AMP2.

See Issue 1.

Freshwater Biology

We monitor the ecological quality of rivers by sampling benthic macroinvertebrates. These are small animals that live in river sediments. They are unable to move far and so are affected by long term conditions in the river.

We collect samples from the river during spring, summer and autumn. 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

TARGETS & STATE OF THE CATCHMENT

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 RJVPACS in the catchment are given on Map 24, page 106. More detailed site descriptions are available from the Bodmin Office of the Environment Agency on request.

State of the Catchment

The biological classification for 1994 is shown below and on Map 24.

<u>Biological Class</u>	<u>Description</u>	<u>River Lengths (km)</u>
A	Good	246.7
B	Moderate	16.1
C	Poor	7.2
D	Very Poor	0.0

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

China clay discharges have had an effect on the fauna of the Tory Brook, with many sensitive families being absent. Tamerton Foliot Stream suffers from chronic organic enrichment which results in low biotic scores. Sites on the upper Tavy have shown a deterioration in stonefly larvae, which can indicate either organic enrichment or elevated pH. There is also a significant absence of mayfly and stonefly larvae on the Haye Valley Stream. There are intermittent problems on the River Yealm, which may be due to organic enrichment or an increase in pH. The water quality on the River Yealm can be variable and the biotic scores reflect this lack of consistency.

As highlighted in section 4.12.1, there is concern for the possible impacts of sewer mis-connections and associated poor water quality in some of the streams in Plymouth, which might be effecting life in the streams and in City Nature Reserves. In order to quantify any impacts biological surveys would need to be undertaken.

See Issues 1, 2, 6.

Non-identified Bathing Waters

Besides the identified EC Bathing Waters (see page 93), we also monitor the quality of four popular, "non-identified" bathing waters in the catchment: Row Cove (Stoke) Beach, Jennycliff Bay, Cawsand Bay and Whitesand Bay (see Map 9).

Data was assessed using the EC Bathing Waters Directive standards for bacteria (total and faecal coliforms). There were no exceedances of these standards at any site in the period 1992 to 1994.

Water Contact Sports

The coastal waters and estuaries of the catchment are used for water contact sports. Our monitoring of EC and non-identified Bathing Waters provides information on water quality close to beaches. This monitoring programme provides information on water quality further offshore, with samples being taken where the recognized activities occur.

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State of the Catchment

Eight sites in the catchment are monitored under the Water Contact Sports programme. These are shown below. Water quality at these sites was assessed using the bacterial standards in the EC Bathing Waters Directive.

Table 29: Water contact sports sites in the Tamar Estuary Catchment

Name	Exceedance of Microbiological Standards under EC Bathing Waters Directive		
	1992	1993	1994
Yealm Estuary (mouth)			
Bovisand Beach			
Wembury Beach			
Plym Estuary			
Plymouth Hoe (East) Beach	YES		YES
Plymouth Hoe (West) Beach	YES	YES	YES
Tamar Estuary (Dockyard)	YES		YES
Tamar Estuary (Tamar Bridge)	YES	YES	YES

Shaded areas show years in which sites were not monitored.

It is expected that the Plymouth Central Clean Sweep scheme (See page 94) will improve water quality at sites in the Plymouth area.

Estuarine/Coastal Water Quality

NWC Estuary Classification Scheme

The NWC Estuary Classification Scheme provides a simple, subjective assessment for estuaries based on points awarded for biological, chemical and aesthetic quality. The classification is as follows:

Estuary Class	Description
A	Good
B	Fair
C	Poor
D	Bad

TARGETS & STATE OF THE CATCHMENT

Each class spans a range of points.

We will shortly be introducing the new GQA chemical classification to monitor and assess the quality of estuaries.

State of the Catchment

All sites achieved Class A.

We have carried out a more objective assessment of water quality in the estuary by looking at routine monitoring data we have collected from 30 sites in the estuary/coastal waters of the catchment which is described below in Passage of Migratory Fish and Microbiological Quality.

Passage of Migratory Fish

Where significant numbers of migratory fish pass through an estuary we may set non-statutory water quality standards for ammonia and dissolved oxygen, as defined in the AMP2 guidance note. We apply these standards during critical periods of the year when salmonid migration is taking place.

Concentrations of total ammonia were highest in the Plym Estuary. It is possible to calculate the concentration of unionised ammonia in saline waters from the concentration of total ammonia. This was done for a number of sites in the catchment where particularly high levels of total ammonia were recorded. All sites met the maximum allowable concentration of 0.25 mg N/l unionised ammonia as specified in the AMP2 Guidelines.

Historically and in recent years there have been a number of fish deaths in the upper reaches of the Tamar Estuary which are believed to have been caused by low levels of dissolved oxygen at certain times of the year. Work undertaken by the Plymouth Marine Laboratories found that the degree of consumption of oxygen at the head of the estuary is linked to the concentration and nature of suspended solids. At spring tides and low river flows greater reductions of oxygen levels occur in conjunction with comparatively high suspended solids and low pH. We are currently investigating the problem, and a report will be published mid-1996.

Issue 9: Oxygen sags in the upper Tamar Estuary leading to fish deaths.

Trophic Status

State of the Catchment

High levels of total oxidised nitrogen (TON) occurred at low salinities in the Yealm, Plym, Tamar and Lynher estuaries. This indicates that TON inputs are coming from freshwater sources such as agricultural runoff. The concentrations of TON were generally highest in the Yealm and Lynher Estuaries.

High levels of orthophosphate occurred at low salinities in the Lynher and Tamar Estuaries. This indicates that orthophosphate inputs are coming from freshwater sources. Concentrations of orthophosphate >100 ug/l were found in all the estuaries.

TARGETS & STATE OF THE CATCHMENT

High concentrations of chlorophyll 'a' occurred at the majority of sites in the period 1990 to 1994. Of these sites, only four showed sustained chlorophyll 'a' concentrations which could be indicative of eutrophication: Yealm at Newton Creek, Tamar off Pentillie Castle, Tamar off Warleigh Point and Lynher at Tiddy.

Although we have collected data which suggests eutrophication may be occurring in certain parts of the estuary, the evidence is not conclusive. Following the next round of Urban Waste Water Treatment Directive (UWWTD) Sensitive Area designations in 1997, we will review the need for further studies into potential eutrophication in the Tamar Estuary.

In recent years horticultural activities around the Lynher have expanded, and there is concern that the increased use of fertilizers could be affecting water quality. Studies are currently being carried out at a number of sites on the Lynher to determine the trophic status of these waters. These include monitoring of chlorophyll 'a' concentrations and a survey of macroalgae (see EC UWWTD, page 100).

See Issue 8

Microbiology Quality

High levels of bacteria were found at all estuary sites in the catchment in the period 1990 to 1994. Bacterial concentrations were highly variable, with numbers at the same site sometimes differing by 4 or 5 orders of magnitude.

There have been considerable problems in the Yealm Estuary at Newton Creek. The freshwater input to Newton Creek drains an agricultural catchment, and receives the discharge from Newton Ferrers STW.

The Plymouth Central Clean Sweep scheme is due to be completed in July 1998. It is expected that there will be some improvement in the levels of bacteria in the Plym Estuary at Cattewater, the Lower Tamar Estuary and in Jennycliff Bay. There should also be an improvement at the Tamar Estuary Dockyard site, as a scheme is being implemented to transfer sewage originating from vessels berthed at Devonport to Camel's Head STW for secondary treatment. Previously, the sewage was discharged untreated to the Hamoaze.

Non-designated Shellfish Waters

There are three sites in the catchment where shellfish are harvested. Oysters are farmed at two sites in the Yealm Estuary, off Newton Ferrers and off Steer Point. Mussels are farmed at one site in the Tamar Estuary, off Jupiter Point. We have monitored water quality and the quality of shellfish (oyster and mussel) tissue at these sites in 1992 and 1993.

State of the Catchment

The concentrations of metals and organochlorine compounds in water samples were all within the Environmental Quality Standards specified in the EC Shellfish Waters Directive.

The concentrations of metals and organochlorine compounds in tissue samples were all within the typical range expected in shellfish, except for copper at the Tamar Estuary site in 1993. The Freshwater Tamar and Tributaries Catchment Management Plan (Ref 1) identified a number of abandoned mine workings and spoil tips which release copper into the lower Tamar River. Sampling for organotin has not been carried out as part of this monitoring.

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Marine Bioaccumulation

Shellfish and seaweed take up certain metals and organic compounds from seawater and concentrate these substances within their tissues. This process is known as bioaccumulation. Analysis of shellfish tissue and/or seaweed gives an indication of contaminants present in seawater. The preferred indicator species are mussels (*Mytilus edulis*) for shellfish and bladder wrack (*Fucus vesiculosus*) for seaweed.

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We have monitored contaminants in shellfish and seaweed at ten sites in the Tamar Estuary catchment, nine estuarine and one coastal.

Organic substances

Most results were below the limits of detection. Positive results for some compounds were recorded at a few sites in the catchment, but in each case concentrations were low.

Metals

Analysis of both shellfish and seaweed indicated that copper and lead were present in high concentrations at all sites. This is to be expected given that extensive mining has taken place in the catchment.

Oil Pollution Planning

The Lord Donaldson Inquiry Report highlighted the high level of vulnerability of our southern coast line and its estuaries. During 1993 and 1994 there were 34 maritime incidents in the UK coastal waters with 17 incidents that could have had serious implications for our regions coastline. The report also highlighted the need for improved levels of strategy by all agencies involved with major oil spills.

A previous NRA Policy Implementation Guidance note stated that we should be responsible in preventing, where practicable, the spread of oil inland from estuaries on incoming tides. We need to prepare action plans in consultation with Local Authorities, MAFF, English Nature etc, to protect wherever feasible sensitive areas of coastline and estuaries. All of these bodies are consulted during the survey.

In order to carry this forward we have started a process of sensitivity mapping and oil spill protection surveys. Details of these projects are given below.

Sensitivity Mapping

This work is essentially geographical and results in the production of maps for each of the Estuaries specified, these maps contain a high level of data relating to the location / area of all the environmental issues currently found in the Estuary, such as: Areas of commercial shellfish harvesting (including periods of greatest environmental sensitivity), Ornithological sensitivity, Amenity value, EC Bathing Waters, Sailing marinas and moorings, Areas of Conservation value, SSSIs, Nature reserves, Heritage coastline, Geological features, Marine conservation importance and Habitat vulnerability along with basic tidal range information.

Oil Spill Protection Surveys

This next phase includes the assessment of practical booming points from the mouth of the Estuary up into the higher tidal reaches, with these boom emplacements being prioritised, access

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points and other logistical points such as: access, boom types to be used, current and other tidal information, rendezvous points, the report and its accompanying plans are extremely useful should a marine oil pollution occur.

Current State

Sensitivity maps for the Tavy, Plym and Yealm Estuaries were completed in detail in 1994. However, they may require updating regarding the habitat sensitivity, location and type of sensitivity ie SSSI or SAC and Marine Conservation Areas.

We will be seeking to complete sensitivity maps for the Tamar and Lynher Estuaries this year. No booming points have been placed within the estuaries

All this work is submitted by ourselves to the County Emergency Plan. This plan is headed by the respective County Council and should provide a joint response to major pollution emergencies.

Oil spill contingency planning is raised as an objective within the Tamar Estuaries Management Plan (Ref 7), particularly to explore the implications of Plymouth City Council becoming a unitary authority. We fully support the inclusion of this objective and will seek full involvement in order to maintain effective contingency plans. To avoid duplication of effort we will seek to use information gathered in the production of that plan to produce any forthcoming sensitivity maps.

Groundwater Quality

EC Groundwater Directive Target

Whilst the EC Groundwater Directive (Ref 31) controls the release of certain substances to groundwaters, there are no statutory standards for groundwater quality. The Environment Agency can only compare water quality with appropriate standards for the 'use' to which groundwaters are put. However, there are no powers for us to ensure that groundwater quality achieves desirable use standards.

Groundwater quality within the catchment is generally reflected by river water quality during dry weather periods when river flow is almost entirely derived from groundwater seepage. This indicates that within the catchment groundwater quality is likely to be suitable for providing river baseflow and supporting identified river water uses.

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A small number of boreholes in the catchment have been sampled but no conclusions can be drawn on the general groundwater quality. This is due to our limited knowledge of geological control on groundwater quality as it links a vast area, varying in three dimensions.

Contaminated drainage from metaliferous mines is of concern within the catchment. The impact on surface waters is described in the beginning of this section.

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

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Groundwater Protection Policy

The protection of aquifers from pollution is of great importance, as the contamination of groundwater may put water supplies at risk. Contamination may also affect river water quality where the baseflow depends on groundwater. Pollution in groundwater is not easy to detect and any clean-up is difficult and expensive. It is better to prevent or reduce the risk of groundwater contamination in the first place rather than try to deal with the consequences.

In 1992 the NRA published its Policy and Practice for the Protection of Groundwater (PPPG) (Ref 20). This document is a national policy which ensures that there is a consistent approach to the prevention of groundwater pollution. It sets out why we must safeguard the quality and flow of water in aquifers and outlines how the Environment Agency with the co-operation of other organisations and individuals will work to reduce risk of groundwater pollution.

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

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

We have mapped the vulnerability of groundwaters in England and Wales and are working on a more detailed classification. The results of this work will be published in 1998.

We work with planning authorities to minimise the risks posed to groundwater from development and land use changes. We have particular concern over the areas around major water supply boreholes.

Target

To protect groundwater from all types of threat, large and small, from point and diffuse sources, and by both persistent and degradable pollutants.

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Redevelopment of sites, particularly the old waste disposal and industrial sites may cause a release of contaminants, which could result in groundwater pollution. A risk assessment study which recommends appropriate mitigation measures would be required as part of each proposal.

A small number of boreholes in the catchment have been sampled but no conclusions can be drawn on the general groundwater quality. This is due to our limited knowledge of geological control on groundwater quality as it links a vast area, varying in three dimensions. Contaminated drainage from metalliferous mines is of particular concern.

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5.2 Water Quantity

5.2.1 Water Resources Strategy & Policy

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

Environment Agency Policies

The NRA published the Regional Water Resources Development Strategy "Tomorrow's Water"(Ref 32) in April 1995. This strategy sets out the approach the Environment Agency will adopt when faced with a resource development proposal. The key policies are to:

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

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

5.2.1 Current and Future Demand For Water

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

Public Water Supply

The catchment straddles two of South West Water's (SWW) Strategic Supply Zones. The area to the west of the Tamar Estuary falls within the Colliford Strategic Supply Zone whilst the area to the east of the estuary falls within the Roadford Strategic Supply Zone.

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For this catchment public water supply must be considered at the strategic zone level rather than the catchment level. Water is exported from the catchment to meet external demand and also imported in order to meet local demand (see Map 17). Hence consideration of a catchment resource-demand balance would be misleading.

Current Resource-Demand Balance

By comparing the current level of developed resources with the current demand for water, an assessment can be made of the "resource-demand balance". The Colliford Zone currently has a drought reliable yield of 166Ml/d, 12Ml/d more than the current average (1992) demand whilst the Roadford Zone has a drought reliable yield of 326Ml/d, 80Ml/d more than current average demand. Clearly, there should be no difficulty in meeting current demands in an average year.

Coping With Droughts

Under prolonged drought conditions when demands are higher than average, for instance as a result of increased garden watering, increased household consumption and a higher number of tourists entering the area problems can arise. They can arise because peaks in demand often coincide with limited resource availability, for example river flows are low and reservoir storages are declining. Added to this there may be constraints in the water company supply network which restrict the movement of water from local areas of surplus to areas of need. Nevertheless, the Environment Agency expects the water company to plan and operate its systems to cope in all but the most extreme circumstances.

The 1995 drought has not altered the Environment Agency's view that there is a resource surplus in the Colliford and Roadford Zones. However, SWW have identified a number of capital investment needs to enable it to take a much greater proportion of its licensed resource than it is currently able to do, especially in the Roadford Zone. Necessary works include intake and distribution system improvements. The Environment Agency has also sought undertakings from the water company regarding operational improvements aimed at minimising the wastage of licensed resources. Specifically, the Environment Agency expects SWW to develop water conservation control rules which, as a drought develops, provide a trigger for actions aimed at safeguarding supplies and preventing unnecessary and environmentally damaging emergency measures. We intend to ensure that these are incorporated within the relevant Operating Agreements for Roadford and Colliford reservoirs.

Issue 10: Operation & Management of Public Water Supply During Droughts.

Future Demand

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.

The Environment Agency has produced demand forecasts for the area served by SWW's Roadford and Colliford Strategic Supply Zones (Tomorrow's Water, Ref 32). Two scenarios have been presented. The 'high' scenario assumes high growth in all consumption, no improvements to reduce losses and no increase in domestic metering to reduce water use. The 'low' scenario assumes low growth in domestic consumption, no growth in industrial/commercial consumption, broad company leakage targets for SWW's of 200 l/property/day and no increase in the proportion of domestic properties subject to metering above 1991 levels.

The 'high' and 'low' demand forecasts for the Roadford and Colliford Zones are shown in the table below for 2001, 2011 and 2021.

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Table 30: Future Demand Forecasts For SWW's Roadford & Colliford Strategic Supply Zones

Strategic Supply Zone	Demand Forecast Scenario	Forecast Average Demand (Ml/day)		
		2001	2011	2021
Colliford	High	169	195	222
	Low	148	164	183
Roadford	High	272	308	347
	Low	243	265	291

For the Colliford Zone, comparing these forecasts to the current drought reliable yield of 166 Ml/d shows that in 2021 under the 'high' scenario there will be a deficit of 57Ml/d whilst under the 'low' scenario there will be a deficit of 17Ml/d. For the Roadford Zone, comparing these forecasts to the current drought reliable yield of 326Ml/d shows that in 2021 under the 'high' scenario there will be a deficit of 21Ml/d but under the low scenario there will be a surplus of 35Ml/d.

Future Options

Under the Environment Agency 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 eastern half of the catchment) until after 2021. However, the Colliford Zone (western half of the catchment) is likely to require a new resource around 2013. If demand rises in accordance with the 'high' scenario there will be a resource deficit in both Zones, Colliford Zone requiring a new resource around 2000, whilst the Roadford Zone would require a new resource around 2015.

The Environment Agency has a duty to secure the best use of developed resources whilst also having regard for the statutory obligations of SWW to provide a reliable supply of potable water to their customers. Whatever the precise pattern of future demand growth the Environment Agency will adopt a staged approach whereby we would ensure that all appropriate demand management, leakage control and resource management options are exhausted before considering the development of new resources (see Tomorrow's Water, Ref 32, for more details).

Demand Management & Leakage Control

The Environment Agency will encourage the promotion of a range of demand management measures including metering of all new properties, selective metering in areas where resources are under stress and the promotion of efficient water use through water saving appliances.

Before considering applications for additional public water supply licences, we expect the water company to set economic leakage targets. We will audit these targets and expect SWW to demonstrate to us that they are being achieved.

Resource Management

We will also require the water company to show us that all existing sources are being managed properly and that where feasible, water will be transferred from areas of surplus to areas of deficit. The aim is to ensure optimal conjunctive use of the various sources within the Zones, whilst taking into account environmental considerations. We will ensure that the relevant Operating Agreements are reviewed at regular intervals to ensure that the operation of the

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Colliford and Roadford Zones keeps pace with growth in demand, in particular the peak demands associated with droughts (see 'Coping With Droughts').

Resource Development

If, despite these measures, new resources are required, the Environment Agency would favour pump storage schemes for the strategic Colliford and Roadford reservoirs. These schemes would involve the pumping of water from further downstream in a catchment at times of high flow. This would be attractive to the Environment Agency because best use would be made of existing reservoirs and it would probably delay the need for any new reservoir developments beyond the planning horizon of 2021. It is possible that sites inside the catchment might be considered as sources for both Colliford and Roadford pumped storage schemes.

Issue 11: Meeting future public water supply demand.

Non - public Water Supply Abstractions

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

Domestic Water Supply

Private water supply abstractions for domestic purposes tend to be very small and to be dispersed across the catchment, in contrast to the more concentrated point sources for public water supply. A large increase in applications is not anticipated.

Spray Irrigation

The catchment already contains a relatively large amount of spray irrigation particularly in the south and east around the Tamar Estuary.

Demand for water for spray irrigation is forecast to increase by 1.7% per year to 2001 and 1% per year from 2002 to 2021. Applying these rates to the current net resource commitment, 201 Ml/year, it is predicted that annual demand for spray irrigation in the catchment will increase by about 70Ml by 2021. Spray irrigation is considered to be a total loss of water abstracted.

However these forecast growth rates are derived from national studies and there is no indication that spray irrigation in the catchment will grow at the rates predicted. Whatever the actual growth rate the Environment Agency will not grant licences for spray irrigation without the development of storage to sustain abstraction during low flows, or at times when groundwater tables are low.

Industry

The forecast growth rate for industry to 2021 is 0.75% per year. However, the growth rate is dependent on other factors:

- changes in the economy; during recession there has been a marked decline in the uptake of private licensed resources for industrial use
- abstraction of water is not a necessary adjunct to industrial growth

Therefore, in reality future growth in industrial water use in the catchment will probably be limited to currently established industries and could largely be met by the increased uptake within already licensed quantities.

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Hydropower

National Powers leat abstractions on the River Tavy are the largest hydropower abstractions in the catchment. (see Table 12). The abstractions at Tavy Cleave, Hillbridge and Abbey Weir were first licensed in the 1960s following the 1963 Water Resources Act. All three are historic rights whose first use dates back some 200 years. The impacts of these abstractions on the river environment are currently subject to a detailed investigation by the Environment Agency (see Section 5.2.2).

It is unlikely that the use of water for hydropower will grow significantly in the catchment as a whole. In a report "Renewable Sources of Electricity in the SWEB Area - Future Prospects" (Ref 33) the authors note that many of the potential sites for new schemes in the South West Electricity Board region, including nine in the catchment, may be unsuitable because of high development costs or environmental considerations.

5.2.2 The Natural Water Environment

Overall the catchment is not stressed by abstraction. However, the level of abstraction on the River Tavy is of particular concern to the Environment Agency and there is also a local low flow problem on the Meavy at Burrator and some potential low flow problems on other rivers, including the Plym and Yealm.

River Tavy

In 1990 a report commissioned by the NRA, "NRA South West Region - Low Flows Study" (Ref 34) cited the Tavy as one of several rivers significantly affected by abstraction. The Environment Agency is currently undertaking a detailed investigation of the impact of abstraction at five sites; National Power's three intakes, SWW Lopwell abstraction and Tavistock Fish Farm.

The investigations have involved:

- Hydrological modelling
- Review of the history (400 yrs) of water use
- Hydrometric monitoring to calibrate the hydrological model
- Physical habitat simulation
- Consultation through 'River Diary' process
- Radio tracking of migratory fish
- Water quality review downstream of Crowndale STW
- Review of prescribed flows at Abbey Weir
- Preliminary environmental cost-benefit analysis.
- Electric-fishing surveys

The environmental and economic issues that need to be addressed and the continued investigations necessary to bring matters to a conclusion are considered below.

National Power abstractions and the SWW abstraction at Lopwell dam (built 1954-56) significantly reduce the freshwater flow to the estuary which in turn may reduce the stimulus to migrating salmon and sea trout. The Environment Agency have been monitoring the progress of salmon tagged in the estuary as they move into freshwater and up the river. The available data will be reviewed to identify any links between fish movement, river flow and abstraction. If sufficient information is available it will be used with results from other studies including PHABSIM (defined in glossary) to help set protective conditions on the National Power

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abstractions at Abbey Weir, Tavy Cleave and Hillbridge. The conditions required at Lopwell will be reassessed once data from a new fish counter at Lopwell is available.

The weir at Lopwell represents an obstacle to salmonid migration encouraging fish to concentrate on the seaward side. The Environment Agency is investigating methods for improving salmonid migration over Lopwell Weir.

The large amounts of water temporarily diverted from the river at Tavy Cleave, Hillbridge, Abbey Weir and Tavistock Fish Farm also reduce the spawning habitat available to salmonids. The PHABSIM software will be used to assess the impact of changes in flow due to abstraction, on the habitat available to key species/life stages. The first phase of the work which is underway will make use of habitat preference criteria from the literature. Results from this work will be used to recommend protective conditions on the abstractions at Tavy Cleave, Hillbridge and Abbey Weir. The second phase will make use of habitat criteria obtained from direct observations of juvenile salmonids in the region's rivers. This information will be used to refine our understanding of how this key life stage is impacted by abstraction.

Issue 12: The effects of abstraction on salmonids in the River Tavy.

The extensive reaches of river deprived of fully natural flows reduces the opportunity for good angling conditions due to diminished width and depth. The Environment Agency will continue to seek the impressions of interested parties on the acceptability of flow for angling via its River Diary Initiative.

Issue 13: Unnatural flow regimes affecting angling conditions on the River Tavy.

The Power Stations at Mary Tavy and Morwellham along with the leats that serve them represent important examples of industrial archaeology and provide ecological and recreational opportunities. The Environment Agency would not wish either site to fall into disuse.

At Mary Tavy reductions in abstraction and the consequent loss of power generation could jeopardise the future of the station. The challenge will be to identify and agree an abstraction regime which provides the river better protection at low flows without threatening the future viability of the station.

At Morwellham the 1978 Abbey Weir Agreement to increase prescribed flows at Abbey Weir in return for compensation for the loss of power generation provides a means of protecting river flows. The Environment Agency does not wish to use the Agreement to completely close the station, even if this were economically justifiable.

It is vital that the amenity, historical and conservation value of the Tavistock Canal is not seriously reduced as a result of reductions of abstraction at Abbey Weir. The Environment Agency have recently initiated a series of trials in the canal to reveal what minimum acceptable conditions are required.

The measurement, monitoring and control of abstraction at Abbey Weir needs to be improved. When flow in the river is below the prescribed flow abstraction into the canal should be limited to that required to maintain minimum acceptable conditions. The Environment Agency is currently drafting an operating manual which will set out how the abstraction will be operated and monitored.

Issue 14: The need to balance flows between the River Tavy and hydropower abstractions.

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Tavistock Fish Farm could benefit from changes to National Power abstractions at Tavy Cleave and Hillbridge. The Environment Agency will study the implications for the Tavistock Fish Farm abstraction and discuss them with the licence holder at the relevant time. The Environment Agency will seek to ensure that any benefits effected by the changes to National Power abstractions are transmitted to the deprived reaches between the fish farm intake and the discharge.

Issue 15: Deprived reach below Tavistock Fish Farm abstraction.

River Meavy, Burrator Reservoir

Low flow issues in the River Meavy are related to the presence and management of Burrator Reservoir. The River Meavy downstream of the reservoir provides a vital spawning and nursery area for salmon. However, the productivity of this 6 km stretch is dependant on adequate flow conditions at spawning time and during the summer period.

Fisheries studies have indicated that juvenile salmon populations are normally very good and do not appear to be detrimentally affected by the relatively low compensation flow from Burrator Reservoir. However, salmon spawning success is dependent on adequate spill from Burrator during the month of December to encourage movement of fish up the river system to spawn.

Recommendations have been made to make special releases from Burrator Reservoir to facilitate salmon spawning in December. Discussions are in progress with SWW to make arrangements for these releases. In the meantime, fisheries studies are continuing to refine our understanding of the problem.

Other Potential Low Flow Problems

In addition to the problems on the River Tavy and at Burrator on the Meavy the report, "NRA South West Region - Low Flows Study " also highlighted a number of other sites in the catchment where abstraction might be having an unacceptable impact on the environment. The English China Clay International abstraction from the River Plym at Ditsworthy Warren and SWW abstractions from the headwaters of the River Yealm were the only two other than the Tavy ranked in the top 19.

A significant proportion of the flow in the River Plym is diverted into the leat at Ditsworthy Weir. The abstraction complies with the Licence of Right (similar in operation to a Licence of Entitlement, see section 4.6) which applies, and only takes within authorised limits. Indeed the abstractor (English China Clay Company) takes less than the authorised amount in order to try and prevent excessive impact. However, in periods of low flows this can still mean that most of the river may be diverted into the leat. Recent monitoring by ourselves has shown that this has been the case on several occasions. We intend to explore with the abstractor the opportunities to reduce the impact of abstraction during critical periods.

Although there has been no work specifically directed at low flows in the headwaters of the River Yealm it is clear that the upper reaches at least are still highly productive for trout despite abstractions from three different tributaries.

No alleviation of low flow investigations are planned at these sites and are unlikely to take place until investigations currently underway in the region are complete. The Environment Agency will review the priority afforded to all sites in the top 19 whether they are currently subject to investigation or not.

Issue 16: Need to review priority of low flow sites in the catchment.

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5.3 Physical Features

Introduction

Although we can control and influence many of the factors which affect the quality of our water environment it has been difficult for us to set targets to protect a minimum amount of a particular habitat or a minimum number of particular plants and animals in the catchment. In partnership with others we now need to bring together existing information on species and habitats and identify gaps in knowledge in order to produce and introduce local Biodiversity Action Plans.

Landscape

River valleys are important parts of the valued landscapes of the catchment. We have a standard survey method which we use to highlight areas which need to be protected or enhanced. Planning authorities can use their powers to protect river valley landscapes.

In recognition of the high landscape value of much of the catchment, about 70% of the area is covered by various landscape designations (see Section 4.1). Through our consenting process we take landscape into account to a high degree in these areas. In addition, when consenting works outside areas of designated landscape value, we consider the visual impact of the proposal when viewed from the protected landscape area.

A discussion document, 'Taking the Tamar Valley towards 2000' (Ref 35) has been produced highlighting landscape characteristics, threats, issues and action needed to improve the situation. Some of these issues are related to the water environment and therefore involve the Environment Agency.

Habitats

As reflected by the high number of landscape designations, much of the catchment displays an unspoilt nature. However, a closer look reveals that considerable areas of semi-natural habitat have been destroyed or damaged for various reasons. A detailed breakdown of semi-natural habitats within the catchment, at 1:10,000 scale based on interpreted aerial photographs, is now possible. For the Devon area this is a paper based system and held at the Bodmin office of the Environment Agency. For the Cornwall area this is on a computer based GIS system, accessed through the Cornwall Wildlife Trust.

River Structure

Land drainage works carried out in recent years have altered many rivers and drained many wetlands. These changes have often damaged their wildlife and amenity value. We recognize that many of these rivers and wetlands could be rehabilitated and a number of schemes are underway in various parts of England and Wales.

River structure is fundamental to the well-being of a variety of related habitats, and the Environment Agency can have direct influence over this through the Land Drainage Consenting process.

In addition, the Environment Agency can have direct influence through its legislation over three important habitat elements:

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i) Riparian Zone

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

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

Issue 17: Need to protect and enhance the riparian strip.

ii) Wetlands

Extensive wetlands occur on Dartmoor around the headwaters of the Tavy, Plym and Yealm, and at other locations in the catchment. Such areas support important plant and animal communities and species, but also have an important natural function as filters, which can have two benefits. Firstly, they slow the rate at which surface water runoff enters watercourses, thereby lowering the erosion potential of the water, and secondly they can encourage suspended solids to settle out of suspension, preventing water quality problems. In drier years, these areas become more significant to livestock farmers because grass continues to grow for longer, allowing grazing to continue.

Concern has been expressed by a number of agencies and individuals over the loss of wetland areas, in particular functional floodplain wetlands. A strategic approach to wetland restoration is lacking, but two current projects are seeking to address this. These are Cornwall Wildlife Trust's 'LIFE' Project and Devon Wildlife Trust's 'A Biodiversity Action Plan for Devon's Rivers and Wetlands' (Ref 36). Recommended habitat and species targets will be set out in these two documents, which the Environment Agency, as a partner in both strategies, will adopt (see also Biodiversity).

Issue 18: Develop the protection of existing wetlands and actively seek opportunities to recreate wetland habitats.

In addition a number of individuals have expressed concern that wetlands on Dartmoor are not as wet as historically, and that this and loss of wetland has affected the flow regime of some moorland rivers.

The Environment Agency does not have any evidence that there has been any marked change in wetlands or in the flow regime of rivers draining Dartmoor. However, it will discuss these concerns with other interested bodies such as the National Park before deciding whether to initiate any research.

Issue 19: Loss of wetland and potential impacts on river flow regimes.

Concern has been raised about the state of surface and groundwater within Plymouth City, particularly volumes, rate of runoff and water quality. These concerns stem from changes noted principally on the Forder Valley Stream, which starts from Plymouth Airport at Roborough and Derriford and flows through Efford Marsh into the Plym Estuary. The stream passes through a number of conservation sites and, including the wildlife corridor, is considered to be one of the most important conservation features within the City, excluding the estuary.

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The pattern of surface and groundwater appears to be changing. Surface waters respond quickly to rainfall with fast heavy flows over a short period, returning quickly to base level flows. These base flows appear to be lower than historically experienced, both during the summer and winter, with increasing areas of the channel bed being left uncovered. This would indicate that flows from groundwater sources are reducing, a fact supported by the noticed drying of wet spring flushes on the valley.

It is thought that increased development within the catchment is the cause of the change, with increasing areas of impermeable surfaces being serviced by surface water sewers to direct the surface water runoff straight to watercourses. This will lead to higher peak flows and lower base flows. There may also be an increase in erosion, as noticed on the Tamerton Foliot Stream. The increase in impermeable surfaces reduces the opportunity for recharge of groundwater. This will particularly affect flows in the summer when groundwater sources become an increasing proportion of the flows in watercourses.

There is no hydrometric data with which to substantiate these observations. In absence of historic records it will not be possible to properly quantify changes. However some hydrometric surveying needs to be undertaken to model current conditions. The information can then be used for future review.

The Environment Agency policy is to object to any new development which may cause or increase the risk of any downstream flooding, however there are two primary alternatives to surface water sewers, soakaways and swales, both of which promote infiltration. Swales are depressions in the ground which hold up water but have overflows for excessive volumes. Given suitable design both are proved to work effectively and are acceptable to the Environment Agency. A further alternative is to reduce areas of impermeable surfaces. Consideration must however be given to the use of the surface to prevent any pollution of ground or surface waters, for example, car parking areas need oil interceptors.

The release of Ministry of Defence land within the city gives the opportunity for further employment land. If the impacts of such development is causing a real problem then developers, Plymouth Development Corporation, Plymouth City Council and the Environment Agency must give careful consideration to the management of surface water runoff in any new proposals.

The adaption of new developments may prevent any problem getting worse. It will not however redress the present situation. It is unlikely to be feasible to undertake work to increase infiltration in developed areas, or other works to increase base flows in surface watercourses. However, work to place check weirs below Efford Marshes might be suitable for retaining water within the marsh system. This is an option which requires further investigation to establish the likely benefits and any threat of causing flooding or increasing flood risk.

Issue 20: Perceived impact of development on ground and surface waters in Plymouth.

iii) Coastal and Intertidal habitats

In addition to the wholly freshwater parts of the catchment, extensive intertidal wetlands - such as mudflats and saltmarsh - occur. Hard coastal habitats occur here also. The Environment Agency can have considerable influence on these habitats through, for example, flood defence maintenance or capital works. We consider our maintenance programmes in a pragmatic way and will look for opportunities to develop 'managed retreat' projects whenever possible. Such projects return an area of coastline to a more natural regime in terms of erosion and deposition, as well as enabling habitat creation or recreation. See Issue 19.

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Information on the saline environment is very fragmented and needs to be brought together in order that sound assessment and management decisions can be made. This issue is raised in the Tamar Estuaries Management Plan, which we fully support. We will seek full involvement in the implementation of objectives where we (as NRA) or Tamar Estuaries Consultative Forum (TECF) are identified.

There are two new European designations proposed for the SSSIs in the estuary complex which are:

Special Area of Conservation (SAC) under the EU Habitats Directive

The EU Habitats Directive aims to maintain the diversity of Europe's wildlife by protecting vulnerable habitats and the plants and animals that depend on them. To help achieve the aims of the Directive, a number of candidate sites were submitted to the EC in 1995. One of the candidate sites is the Plymouth Sound and Estuaries SAC. The Directive encourages wise use of an area without detriment to the environment, based on the principle of sustainability, and may best be implemented by the introduction of appropriate management schemes.

Special Protection Area under the EU Birds Directive

Provides for the protection, management and control of all species of naturally occurring wild birds, with special measures to conserve the habitat of certain rare species and migratory species.

The Environment Agency would be considered both a Relevant and Competent Authority within the meaning of the Regulations, having implications for how we use our powers and resources. Any changes in operation (including any review of existing licences) would be driven by conservation objectives drawn up once the SAC is designated. With our conservation duties it is likely that we would be involved in setting conservation objectives. In order to establish a baseline of information on which to be able to make informed decisions English Nature are funding a project entitled "Broad scale biological mapping of subtidal and intertidal coastal areas: Plymouth Sound and Estuaries", due to start in 1997. The designation of the estuary as a SAC will also have implications for other members of the Tamar Estuaries Management Plan steering group. The subject is therefore also raised within that plan and we will be supporting measures to ensure the use of our combined powers to support any SAC objectives.

We have signed a Memorandum of Understanding (MoU) with English Nature which will lead initially to the production of agreed conservation strategies and consenting protocols for River SSSIs and SACs; there are no river SSSIs in this catchment, but the MoU will provide a model for SPAs and Ramsar sites where we have a significant consenting.

Issue 21: Need to identify key species and habitat requirements for SAC and SPA.

An essential part of the ability of the Environment Agency to protect habitat effectively is the provision of accurate habitat survey information and interpretation, and where possible, the notification of each County's most important sites as 'County Wildlife Sites'. In Cornwall, this system is set up and works well, with frequent liaison between the Environment Agency and Cornwall Wildlife Trust over proposals affecting such areas. In Devon, this task is not yet complete and we will support, with funding if possible, the completion of the process.

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Biodiversity

Target : To assist in the development and delivery of Biodiversity Action Plan for rivers and wetlands in the catchment.

Biodiversity quite simply refers to the variety of life on Earth. We are losing biodiversity. We have also lost over 100 species in the UK this century; globally half of all species of birds and mammals could be extinct within the next thirty years.

The conservation and enhancement of biodiversity must be integrated into all our decision-making. Targets need to be set to prevent further loss and guide recovery.

The recently published document 'Biodiversity: the UK Steering Group Report' (Ref 37) contains costed targets and actions for the protection and restoration of priority habitats and species up to the years 2000 and 2010. Regional and County Biodiversity Action Plans will give the local focus. 'The Biodiversity of the South West: An Audit of the South West Biological Resource' has been produced by a partnership of organisations - the County Wildlife Trusts, RSPB and the Regional Planning Conference.

We are a partner in the production of 'A Biodiversity Action Plan for Devon's Rivers and Wetlands' (Ref 48). This Action Plan consultation document has been recently published and just finished a period of consultation. It contains specific biodiversity action plans for a series of features, habitats and species. Some species will benefit from broad habitat actions, achieved by many bodies applying appropriate policies and actions, e.g. estuarine birds. For others specific action is required, e.g. protection of breeding sites for sand martins.

The Environment Agency is identified as being the co-ordinating body (sometimes jointly) for a number of Action Plans. These are all linked to the water environment, reflecting previous involvement and expertise. Additionally, we are identified as having a role to play in the delivery of Action Plans for other habitats and species. The document covers the majority of this catchment and we will seek to adopt and implement the recommendations of relevant Action Plans. There is a need to expand the process to take in saltwater habitats and species.

Issue 22: The need to develop and deliver biodiversity actions.

Species Protection

It is felt that the UK Steering Group Report, supported by regional and local biodiversity action plans will set the agenda for targeting the protection of rare species in this catchment. We have been identified to be the lead body for certain water related species.

The Salmonid Fishery

Target : Optimising the size of the natural Salmonid fishery to fulfill its environmental capacity.

An exact target for the maximum carrying capacity for salmonids has not yet been established on the freshwaters in the catchment. However the Environment Agency is currently involved in implementing a classification scheme following a research and development project. This will enable us to set targets for the catchment and also to put the fisheries into a national context.

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The National Strategy for the management of salmon fisheries in England and Wales was published in February 1996 (Ref 38). The Strategy sets out four clear objectives:

- * Optimise recruitment to home water fisheries
- * Maintain and improve the diversity and fitness of stocks
- * Optimise the total economic value of exploited fish whilst allowing for social equity considerations
- * Meet the necessary costs of managing the resource.

The Strategy provides a new approach to salmon management, driven by the setting of targets, monitoring of stocks and performance of fisheries. Spawning targets will be set for all major salmon rivers and will form the basis of individual Salmon Action Plans for each river catchment. These will build on the analysis of stocks and conditions undertaken in the following text.

Salmon Action Plans for the Rivers Tamar and Lynher will be produced in 1996/97, followed by the River Tavy in 1997/98 and River Plym in 2000/01. They will incorporate a period of public consultation.

The natural fisheries of the catchment are of good quality within the River Lynher, River Tavy, upper River Plym, River Meavy and upper River Yealm. The Tory Brook shows particularly strong contrasts with two good tributaries and an extremely depleted main river fishery (see also Section 4.2 and Appendix B). Within the Tamar Estuary the main Environment Agency target is the protection of adult salmonids during their return migration through estuarine waters.

River Lynher

The juvenile salmon stock is found in the middle and lower reaches of the Lynher. The Withey Brook is inaccessible to salmon and sea trout due to a series of impassable waterfalls. Otherwise the Lynher has no substantial tributaries and very few juvenile salmon have been found in those surveyed.

The Tiddy has a small salmon run usually producing moderate concentrations of salmon fry in the upper reaches, though poor in 1993. Salmon parr are spread very thinly throughout the Tiddy with the exception of the lowest site in 1980 where an unusually high salmon parr density was recorded. Low densities of salmon were present on the Haylake Stream although it contains a good trout population.

The trout stock in the Lynher subcatchment is mostly concentrated upstream of Trebartha with high trout fry densities. Trout parr abundance is also high above Trebartha with moderate levels throughout the remainder of the river. A good trout population is evident within the Withey Brook (an isolated population) and the Deans Brook. The Darleyford Stream was found fishless in 1981. A survey in 1980 of the Caddapit Stream revealed a poor fish population.

Tamar Estuary

Although late salmon spawn below Gunnislake Weir in tidal waters and sporadically in the lower part of St Dominic Stream, the main production areas are the Inny, Lyd and Ottery. These rivers are described in the Freshwater Tamar and Tributaries Catchment Management Plan (Ref 1). There is no evidence of trout spawning below Gunnislake Weir, although they do spawn in the St Dominic and Danescombe Stream.

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River Tavy

The main stock of juvenile salmon are located throughout the main Tavy below Hill Bridge and on the Walkham, sometimes as far upstream as Merrivale. Other important tributaries for salmon include the Willsworthy Brook, Youlden Brook, Colley Brook, River Burn and Mount Tavy Stream. Tributaries with evidence of sporadic salmon spawning include the lower part of the Cholwell brook, Wallabrook, River Lumburn, Tiddy Brook, Withill Stream, Black Brook and the Milton Coombe stream. There is no evidence of successful salmon spawning on the Baggator brook, main Tavy (above Coffin wood), on the Cholwell Brook (above Mary Tavy), on the Mount Tavy Stream (above Mount House lake), on the Walkham at Greenaball (headwaters), Eggworthy Stream, Brook Stream and the Tamerton Foliot Stream (see Appendix B).

The main trout fry production occurs within the following tributaries: Baggator Brook, Willsworthy Brook, Youlden Brook, River Burn, Wallabrook, upper part of Mount Tavy Stream, upper Lumburn, upper Walkham, Withill Stream, Eggworthy, Black Brook and the upper reaches of the Tamerton Foliot Stream. Areas where trout fry production is less consistent include the upper Tavy, Cholwell brook, Tiddy Brook, River Lumburn and the Walkham. Good densities of older trout are consistently found in the upper Tavy (above Tavy Cleave), Baggator Brook, Willsworthy Brook, Youlden Brook, upper Cholwell Brook, Colley Brook, River Burn, Wallabrook, Mount Tavy Stream, Tiddy Brook, River Lumburn, upper River Walkham, Withill, Eggworthy, Black Brook, Brook Stream and Milton Coombe Stream. Areas where trout parr abundance is not necessarily good include: Cholwell Brook (around Mary Tavy), lower Walkham and the lower Tamerton Foliot survey site.

River Plym

The juvenile salmon stock is concentrated on the Meavy (below Burrator reservoir) and to a lesser extent on the lower Plym downstream of the Meavy/Plym confluence. Sporadic usage by salmon of all small tributaries occurs but juvenile abundance is low. Juvenile salmon have not been located on the Plym, upstream of Dewerstone Falls.

The juvenile trout stock is high within the upper Plym and throughout the Meavy. Tributaries of the upper Plym and Meavy have good trout populations. The lower Plym has a low abundance of trout. Tributaries surveyed within the lower Plym that have poor trout populations include Glenholt and Happy Valley Stream.

The main Tory Brook is severely affected by china clay discharges and has declined in fish species richness since its first thorough fish survey in 1992 and is now devoid of salmonids from the ECC Clay works to the Plym Estuary. However two tributaries (Smallhanger Brook and Elfordleigh Brook) have good trout populations despite the poorer state of the Tory Brook.

River Yealm

The juvenile salmon stock is concentrated in the middle reaches of the Yealm (upstream limit Blachford Lake). Sporadic usage by juvenile salmon of all surveyed main Yealm tributaries occurs but juvenile abundance is often low. Juvenile salmon have not been located in any streams that directly enter the Yealm Estuary.

The juvenile trout stock is very high from Cornwood upstream, particularly above Blachford Lake. Although there are productive areas within the catchment, there is room for improvement, particularly on the lower Yealm and all its tributaries. A number of tributaries on the Yealm

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have shown declining trout populations since first surveyed in 1987 including the Ridgect Lake, Brook Lake and Long Brook. Poor juvenile trout densities continue on the Lee Mill Stream, Fordbrook and lower part of the Newton Ferrers Stream.

Within the catchment major constraints on the fisheries are thought to be due to the following reasons:

Poor water quality

During extreme drought conditions the Tamar Estuary water can become hazardous to adult salmon and sea trout. A combination of warm estuarine water and low freshwater flows can lead to oxygen levels that are below those required to sustain salmonids (see Passage of Migratory Fish, page 110). It is presumed that these conditions, combined with high levels of suspended solids and Spring Tides, lead to the deaths of adult salmon within the Tamar Estuary. During 1976 over 100 salmon were found dead in the estuary. The above conditions are locally alleviated around Morwellham power station due to the release of River Tavy water from the power station via a waterfall.

Fish deaths in the Upper Tamar Estuary, see Issue 9.

Poor water quality is noted on some rivers in the catchment due to persistent inputs, i.e. agricultural runoff or mining, or individual pollution incidents. These issues have been looked at in Section 5.1.

Spawning gravels

Two areas of concern have been identified that could account for lower than expected salmonid production:

i) Lack of gravel

The lack of spawning gravel identified in the area immediately below Blachford Lake on the River Yealm was addressed in 1993 by importing gravel into areas above gravel retaining check weirs. Monitoring of the site will need to be continued to assess the effect of the operation.

The lack of spawning gravel found between Jewells Leat abstraction point and Coffin Wood has been identified by the Environment Agency. This is the current upstream limit of salmon migration within the main Tavy. Lack of funds and difficult access has meant that this work has not been carried out. A need for gravel replacement has been identified between Burrator dam and the Sheepstor Brook confluence on the River Plym.

ii) Suitability of gravel

Spawning gravel rehabilitation has been carried out at the following locations in order to increase spawning areas for returning salmonids:

- * Gravel rehabilitation at Bathpool (River Lynher) 1992-4.
- * Check weirs built to form spawning beds at Cadover Bridge (River Plym)
- * Trash dam clearances on the Rivers Lumburn and Lynher.

In addition there are other areas where existing gravels are thought to be in an unsuitable condition for spawning. The River Lumburn has a good trout population but salmon production is sporadic. The low salmon production may be associated with siltation of eggs in the gravel.

Map 25 - Weirs and Obstacles to Fish



Information correct as of November 1995

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Tamar Estuary and Tributaries Local Environment Agency Plan
Environment Agency

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A number of rivers, such as the Piall, Yealm, Tory Brook and Plym have been affected by suspended solids inputs from the china clay industry. These have led to compacted and concreted gravels, unsuitable for salmonid spawning. With improvements to china clay discharges and general water quality an opportunity now exists to try and 'break up' the river bed to provide spawning areas. An assessment of gravel compaction is therefore needed to highlight areas that can be successfully utilised by adult salmonids. On the river Plym, sand is also building up below the confluence with the River Meavy which may be causing a problem. A review of the source of the sand and possible action is required.

Other rivers such as the Lynher, may have limited spawning gravels. On the Lynher there is poor salmon fry production at Stara Bridge, Rilla Mill and Kearney Bridge. There is a requirement to assess areas which would benefit from cleaning natural gravels.

Issue 23: Unsuitability or lack of spawning gravels reducing salmonid production.

Construction of instream structures

Whilst greatly benefiting the river for fishing purposes, instream structures such as croys may also prove detrimental to the fish stocks as a whole, as well as the general environment and landscape of the river. If placed in inappropriate locations, croys might prevent spawning. There is a need for a protocol to ensure best practice for the positioning and construction of instream structures, a need highlighted in previous NRA Catchment Management Plans. Structures already in place should be assessed as to their impact on spawning.

Issue 24: Inappropriate construction and location of instream structures.

Obstructions/Access

Access to spawning gravels by migratory fish may be limited by natural and manmade obstructions. Complete manmade blockages prevent fish reaching and using spawning grounds, while partial manmade blockages reduce the level of spawning. Both prevent the fishery achieving its natural potential.

Access to spawning areas may be limited by major physical obstructions, largely trash dams (dams forming from wood and other natural debris). The Environment Agency 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, erosion and siltation of gravels.

However, overhanging trees and smaller blockages are a natural part of the river system. They provide substrate, food and shelter for in-stream organisms and may scour out pools and possibly rejuvenate gravels downstream. We recognise the importance of these effects on all river life and follow an internal code of "best practice", which is being formalised (Seaton, Looe and Fowey Action Plan, Ref 39) on where and how to clear trash dams.

Where practicable and desirable we try and engineer improvements to natural and manmade barriers, such as waterfalls or weirs. Unless placed illegally, this requires the co-operation of landowners and other agencies to agree, fund and carry out the work. Within the catchment there are numerous obstructions, given in Table 31 and shown on Map 25. This list is not likely to be totally exhaustive.

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Table 31: Obstacles impassable or partially passable to fish

River	Obstacle Name	Type	Passable/ impassable
Lynher	Clapper Weir	Weir	Passable under certain conditions
Withey Brook	Trebartha	Waterfalls	Impassable to migratory salmonids
Tavy System	Miltoncombe	Floodgates	Passable under certain conditions
	Blackbrook weir	Disused leat	Passable under certain conditions
	Wallabrook weirs	Disused ram pump weirs	Passable under certain conditions
	Mount Tavy weir	Weir	Appears impassable to salmon
	Withill	Natural	Passable under certain conditions
Baggator Brook	Unnamed	Waterfall	Passable under certain conditions
Cholwell Brook	Unnamed	Waterfall	Impassable
Plym System	Burrator Dam	SWW reservoir	Impassable
	Ditsworthy weir	China clay water supply	Passable in high flows
	Dewerstone Falls	Waterfall	Passable to sea trout
	Sheepstor Falls	Waterfall	Impassable
Yealm System	Head weir	Weir	Passable under certain conditions
	Storridge Wood weir	Weir	Passable under certain conditions
	Langham Bridge	Concrete based bridge	Passable under certain conditions
	Blachford Lake d/s weir	Weir of shallow gradient, 40m long	Passable under certain conditions
	Blachford Lake u/s weir	Weir of steep gradient, 7m long	Passable only in exceptional circumstances
	Dendles Wood	SWW weir	Impassable
	Kitley Lake	Waterfall	Passable under certain conditions
	Silverbridge Lake	Private lake	Unknown
	Delamore Lakes	Private lake	Unknown
	Broadall	SWW weir	Passable under certain conditions
	Ford Brook	SWW weir	Unknown

Table 31 shows that there are numerous obstructions which may be holding back the development of the fishery. Further work needs to be done to identify those obstructions where action should be taken to improve access.

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In addition to improving access, attention needs to be paid to the maintenance of structures so that they remain passable. Foxhams and Sergeants weirs on the River Tavy have been identified by the Environment Agency as requiring attention but due to a lack of available funds have not yet been repaired. Regular checks on the condition and maintenance of all weirs is required to maintain access for migratory fish.

Issue 25: Obstructions to fish migration requiring improvement or maintenance.

There are regular problems with salmonids dropping through screens at the following abstraction points and then smolting in the associated leats: River Tavy, Tavy Cleave (Jewells Leat), Hill Bridge (Bennetts Leat) and Abbey Bridge (Morwellham Canal); River Plym, Ditsworthy Leat; River Lynher, Rilla Mill and Addicraft. An investigation of the most effective screens to prevent the ingress of salmonids at abstraction points and of improved positioning of abstraction points is the subject of a current consultancy report.

Issue 26: Loss of salmonids at abstraction points.

River Flows

The impacts of river flows on the fisheries is discussed in Section 5.2.2.

Rod Catches

Declared rod catches are not always sound statistics on which to base fishery management. They vary considerably due to degree of reportage and have no link with the amount of effort involved. They can only be expected to give a very broad picture as to the health of the fish population.

However, low rod catches are perceived as a problem on several rivers (Yealm, Tavy, Lynher, Plym). Extensions to the fishing season on various rivers have produced increased rod catch figures, some short lived. It is clear that little is known about the impact on fish stocks of changes to the fishing season.

The Salmon Management Strategy should provide a better framework for ensuring the sustainability of fish stocks. Rivers experiencing a true lack of rod caught fish will need further investigation to identify the cause. For example, the River Tavy rod catches are thought to be severely affected by licensed netting in the estuary coupled with the obstructing nature of Lopwell Dam.

Issue 27: Rod catches lower than expectations on the Rivers Tavy, Plym, Lynher and Yealm.

In 1989 and 1990 dry summers were thought to be the cause of the low salmon rod catches reported. 1991 was a particularly poor year for salmon rod and net catches across all catchments entering Plymouth Sound, but was not a drought year. These events could have resulted in reduced fry and parr production in following years.

Particular stock components

Multi Sea Winter Salmon : Since the early 1970s the proportion of grilse to two sea winter salmon (2SW) has altered and there is currently a much higher proportion of grilse in the Lynher, Tamar and Tavy populations. Within this component there has been noted a significant decline in returning numbers of spring salmon on the Lynher, Tamar and Tavy which reflects a regional trend. It is most likely that factors at sea are largely responsible for this decrease.

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However they have reached levels where we feel it necessary to consider action. The Environment Agency South Western Region will assist in promoting a National investigation into the decline of multi-sea winter salmon and will consider possible measures to increase escapement.

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

Issue 28: Decline in catch of multi sea winter salmon (including spring salmon) and sea trout.

Little information on the various ages of sea trout exist to determine any long term changes in the abundance of different age classes within the adult stock. A larger database of scales is required, collected over a longer period of time. More current scale reading information is also required for adult salmon from the Lynher, Tamar and Tavy to aid our understanding of the reduction in the spring salmon run.

Too little historic information on the various ages of River Plym and River Yealm adult salmon exists to determine any long term changes in abundance of different ages within the adult stock.

Issue 29: Insufficient age class data for adult salmon and sea trout particularly on the Rivers Plym, Yealm, and Lynher.

Eel populations

Eels are a natural resource as they are fished for by man, birds and animals. Various licences are granted by the Environment Agency for the capture of eels and elvers, and we have received renewed interest for licences. Eels are also a main foodsource of otters. In order to properly manage the resource we need to have a better understanding of eel populations. Data can be collected as part of our routine surveys. The study of eel tissue can also reveal the level of bioaccumulation of toxins (such as metals and pesticides) and their suitability as a food source.

Issue 30: Insufficient knowledge of eel populations to enable sustainable management.

Net Limitation Order

Net Limitation Orders are currently being renegotiated and renewed for the Lynher, Tamar and Tavy estuary nets.

Poaching of salmonids and juvenile bass

Poaching is a major problem within the catchment, particularly within the estuary. Illegal netting occurs within all the estuaries although this has been curbed by Devon Sea Fishery Committee (DSFC) byelaw 19 and the MAFF Bass Nursery Area Regulations. Rigorous and high profile enforcement within the rivers and estuaries needs to be maintained by the Environment Agency, MAFF and DSFC.

Issue 31: Illegal exploitation of salmonids and juvenile bass.

In addition rod licence evasion can be a problem. Rod licence income is essential for maintaining protection of rivers and fish stocks. Through greater publicity of the Environment Agency and the legal requirement to buy a rod licence we will seek to increase rod licence sales.

Issue 32: Loss of income due to rod licence evasion.

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In light of the new Environment Act 1995 (Ref 16) a review of the sea fisheries byelaws could highlight ways in which fish populations in designated areas could be better protected.

Information about the byelaws has been publicised throughout the area. There are many regulations in effect in the Tamar Estuary to protect the fishery. Leaflets have previously been produced by the NRA and through the Tamar Estuaries Management Plan (Ref 7). They are available at tackle shops and tourist information outlets, however greater publicity of the regulations is needed in estuary areas. The issue is also raised in the Tamar Estuaries Management Plan and we would look for integrated action in any implementation.

Issue 33: The need for a review of sea fisheries byelaws and increased publicity of fisheries regulations in the Tamar Estuary.

Longlines, groundlines, shellfish collection, bait digging and crab collection

All of these activities fall under the responsibility of the Devon Sea Fisheries Committee. Shellfish collection has been discussed in section 4.2. Bait digging and crab collection are activities which can often cause local concern. This is so in parts of the Tamar Estuary complex where crab trapping is practised. It is raised within the Tamar Estuaries Management Plan (Ref 7). A 1 year research project on the impact of trapping is being carried out through the University of Plymouth.

As stated in Section 4.2.1, there are designated shellfish areas within the catchment which are currently not being used. There are a number of different bodies which would be involved in any future development of shellfisheries. There might be a need to formulate a framework for coordinating future development, though this will most likely be driven by commercial interest.

Natural predation

Natural predation of fish by mammals and birds occurs throughout the fishery. At present it is not known if this is having a significant impact on fish stocks. The Environment Agency works with fisheries owners and MAFF to advise on preventative measures. Licences to kill predators are issued by MAFF. The Environment Agency 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.

Issue 34: Natural predation of fish stocks.

Introduced and escaped fish

Within the catchment there are stillwater lakes containing a variety of fish species not found within the river system. We are concerned about the occurrence and impact of fish escapees on native species.

Issue 35: Introduction of non-native fish species into freshwater and the marine environment.

Spawning of protected or rare fish species

Salmon and sea trout spawn throughout the freshwater catchment. Shad (thought to be twaite shad) may breed within the estuary (or lower Tamar) and are quite often caught by estuary salmon netmen. One shad was caught in the upstream fish trap at Gunnislake weir. Shad are listed within the European Union Species and Habitats Directive, 1992 (Ref 40) and are protected by the Wildlife and Countryside Act, 1981 (Ref 41). Sea lamprey are known to spawn above and below Gunnislake weir and are listed in the EU Species and Habitats Directive. Sea lamprey have been observed in the lower reaches of the Lynher, but no proof of breeding as yet exists. Little is known about smelt although they apparently spawn up and downstream of Gunnislake weir and are listed by the Environment Agency as nationally threatened.

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Brook lamprey occur at a number of sites within the Rivers Lynher, Tavy and Yealm, but are very uncommon on the River Plym.

Grayling have been caught in tidal waters below Gunnislake weir. Their occurrence in the Tamar system dates back to an artificial stocking between 1899 and 1909 (see Freshwater Tamar and Tributaries Catchment Management Plan, Ref 1).

Issue 36: Protection of endangered fish species and their spawning habitat.

Freshwater Invertebrates

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

The Environment Agency carries out an invertebrate monitoring programme throughout the Tamar Catchment. The results of this work are used primarily for water quality assessment, however substrate (habitat) must be taken into account and they therefore also act as a wider biological indicator. One of the major features of biological monitoring is that, once the invertebrate community has been impacted by a pollutant, its effect can be recorded for many months after the event. Stretches of river where the invertebrate community has been impacted have been highlighted in Section 5.1.

Within this particular catchment a specific need has been identified to assess the invertebrate community of the Tavistock Canal, as proposals to alter the flow regime have been discussed (see 5.2.2). A number of other sites within the catchment will be surveyed to provide base-line monitoring information, but their location has yet to be finalised.

Marine Biology

A survey of the Benthic Macroinvertebrate Infauna of the Tamar Estuary was undertaken for the NRA by the University of Exeter, using data from samples collected in 1992.

The upper Tamar and Tavy Estuaries have similar benthic communities to many Cornish estuaries with *Tubificoides costans* (an oligochaete worm) and *Nereis diversicolor* (a rag worm) dominant. As salinity levels increase community structure generally becomes more complex with species richness increasing. Comparison with earlier survey work has shown that since 1932 the community has not changed significantly although a reduction in the mollusc community was apparent.

The benthic community in the Lynher Estuary was well populated and diverse, comparison with earlier research work indicates no significant changes but the mollusc community (especially bivalves) has decreased. Further work could show whether this was because of organic pollution effects or simply a sampling effect.

Issue 37: General decline in the mollusc community (particularly bivalves) at monitored sites.

A similar pattern emerges for the Tamar Estuary with the apparent loss of the tellin community. Recent work suggests some evidence impact on the macroinvertebrate community from organic enrichment occurring in the vicinity of Devonport Naval Dockyard, though the discharges have been occurring for some time.

Issue 38: Effect on macroinvertebrates of organic enrichment in the vicinity of Devonport Dockyard.

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Generally in the Plym Estuary diversity and species richness were high despite the china clay sediments (kaolin) dominating the upper estuary.

The estuary communities showed a gradient in species diversity, improving in community structure and decreasing dominance levels from the upper estuary to the Plymouth Sound sites. Intertidal communities in the estuary were *Macoma* communities with *Nereis diversicolor*, *Tubifex costatus* (oligochaete worm) and *Corophium volutator* (small crustacean) dominant in lower salinity upper estuarine sites and *Nephtys hombergii* (rag worm) and *Ampharete acutifrons* (tube dwelling worm) characteristic of the higher salinity lower estuary sites. Subtidal macrofaunal communities were richest in the lower estuary and Sound.

Invasive Species

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

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

Under the Wildlife and Countryside Act 1981(Ref 41) it is an offence to plant or otherwise cause Japanese Knotweed and Giant Hogweed (which can be harmful to humans) to grow in the wild. Himalayan Balsam has yet to be included in this Act. Japanese Knotweed and Himalayan Balsam are present throughout the catchment, though their full extent is not known. Impacts on native species can be locally significant and work needs to be done to monitor both spread and impact.

The problem has a fairly high public profile in some areas and requires action, by landowners and managers as well as the Environment Agency. It is recognized that Japanese Knotweed is particularly suited to spreading along watercourses and can colonise areas quickly. It is a problem species found on many South West rivers and could involve considerable resources to try and undertake control. Therefore we would consider that effort should be targeted at locations where impact is both known and significant. Effective control is dependant on co-ordinated, catchment wide action. The NRA has produced a leaflet "Guidance for the control of invasive plants near watercourses"(Ref 42)and is continuing research into these invasive species.

The invasive seaweed *Sargassum muticum*, commonly known as 'Japweed', can cause problems in estuarine waters by smothering other growth. It is not known whether there is a problem with this plant in the catchment.

Issue 39: Assess the extent and impact of invasive species.

Historic Environment

The historic environment of the catchment is rich and varied, as seen in the range and number of designations, however there is a relative lack of general information on the resource.

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

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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 35), and conversations with County archaeologists and Dartmoor National Park) though the Duchy of Cornwall have carried out an assessment on their holdings. An assessment of the underwater archaeology of Plymouth Sound (Ref 43) has also highlighted similar problems and discusses a framework for future management.

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

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. Specific objectives with suggested implementation for maritime archaeology have been identified in the Tamar Estuaries Management Plan (Ref 7). As a member of the plan steering group we fully support the objectives contained and where appropriate will help in their implementation.

As mentioned in the 'Catchment Uses' section, knowledge of historic tips or other certain types of land use can have great relevance today.

Issue 40: Need for an assessment of the historic environment of the whole catchment.

Recreation

Partnership with other bodies

Much of this catchment has a high level of water-related recreational use. Two recent surveys have detailed the use of the Tamar Basin for recreation, and to save duplication here these should be referred to:

- 1) Review of the Port of Plymouth Area Recreation Study, 1992. (Concentrates on sailing).
- 2) Recreational Usage and Issues on and around the Waters of Plymouth and the Tamar Basin, 1994. (Concentrates on important recreational activities on water and adjacent banks, excluding sailing).

The latter project, commissioned by the NRA as part of the 'Tamar Estuaries Management Plan' had two general aims:

- 1) To hold a wide consultation with user groups to voice their concerns and aspirations and to discuss future management;
- 2) To formulate policies to provide for the improved enjoyment and sustained development of the recreational resource. Policy proposals have been generated, for inclusion in the Tamar Estuaries Management Plan (Ref 7).

The plan highlights a number of objectives for public access to the Tamar Estuaries and Plymouth Sound. Actions for implementation and possible organisations involved are suggested. The Environment Agency supports these aims and where we are able will develop and implement issues raised.

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Another document that highlights issues that we would wish to become involved in is the Tamar Valley Countryside Services's 'Tamar 2000'.

Issue 41: To assist in the development of the numerous recreation issues brought to light in the Tamar Estuaries Management Plan and 'Tamar 2000' wherever we are able .

The Dartmoor National Park Authority is concerned about a number of heavily-used sites such as Shaugh Bridge, Bedford Bridge, Grenofen Bridge, Cadover Bridge and Burrator Reservoir. The Park Authority is currently looking to draw up management statements for these sites and would look to other agencies to have an input where appropriate. Anglers on the River Plym have raised concerns about the erosion of the path alongside the river at Plym Woods.

Developing new recreational opportunities away from such locations would help to maintain environmental quality in those areas currently under pressure. We would support such initiatives, provided that careful management of the activities takes place so as to prevent disturbance to ecologically sensitive elements of the catchment.

Issue 42: Environmental impact at heavily used recreational sites in the freshwater system.

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5.4. Flood Defence

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.

At any location the Standard of Service for flood protection is the worst flood (expressed as a return period) which can be withstood without significant damage. The Environment Agency sets target standards, which are related to the nature and scale of risk, so that resources can be used most effectively. For example the target standard to defend a town against the sea will be higher than that for marginal farmland in the floodplain of a river.

The Environment Agency seeks to guide new development away from flood risk areas, and to maintain main rivers and existing defences, so that target standards are met. New or improved defences may sometimes be justified, although a flood alleviation scheme cannot remove all risk since a more serious flood may still occur. Flood warnings are an important means of limiting damage where risks cannot otherwise be avoided.

We manage flood defence by addressing the difference between targets and existing standards. Targets may be applied generally or to any of the main areas of flood defence activity: regulation, maintenance, improvements or emergency response.

General Targets

Target: To manage flood defence by addressing the differences between target and actual Standards of Service, by 1997.

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

Issue 43: Need for a fully integrated Flood Defence Management Manual and supporting System.

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

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

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Regulation

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

Target: To provide planning authorities with sufficient information to ensure that the effects of development on flood risk are properly considered in accordance with the Department of Environment Circular 30/92 'Development and Flood Risk.' (Ref 18).

State: Information is currently provided on the basis of historic flood records and survey data. The requirements for improved information have been agreed with planning authorities.

A programme of flood risk data survey, interpretation and provision to planning authorities is in hand and is being carried out in accordance with a Memorandum of Understanding drawn up between the Environment Agency and the Associations of County Councils, District Councils and Metropolitan Authorities. This takes account of the timetable of District Wide Local Plans where possible but may not be available in time in some cases.

Issue 44: The need to identify flood risk for planning authorities. This should take account of the timetable for preparing district wide Local Plan(s).

A contract was awarded in 1995/1996 to produce indicative floodplain information for this LEAP area. These plans should be available to local authorities by Spring 1997.

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

State: Apart from our input to Local Plans mentioned earlier, we comment on a routine basis on planning applications and developers' enquiries.

Development can itself be subject to flooding if sited in an area liable to flood. Flooding downstream can be aggravated by extra runoff from new development and existing development can be put at risk if flood protection works are compromised by new development.

Issue 45: Flooding downstream from existing and new development.

Action: We will continue to maintain an up-to-date record of locations at risk from flooding, of catchments where additional development could increase the frequency of flooding downstream and of Environment Agency flood defence works.

Improvements

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

Different types of land and property need different levels of protection. We use the indicative standards shown in Table 32 (return period in years) to design schemes.

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Table 32: Indicative standards for the design of Flood Defence Schemes

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

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

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

Target: To identify and investigate all flood risk locations.

State: We maintain a register of flood problems. These may be identified through a flooding event or through special surveys which we undertake from time to time. Those problems which, after initial investigation, may justify new or improvement works by the Environment Agency are included in a list of long term needs from which the capital programme is prepared. The Longbrook in Plympton is one river which has possibilities for improvement. However much of the data used is old and it is felt that it needs to be updated.

Issue 46: The need to update the database of flood risk locations for potential capital works.

Flood problems will be reviewed as part of the Section 105 survey - Development and Flood Risk. Indicative floodplain information will be available for the whole catchment by Summer 1996 (See issue 44). Where significant numbers of properties are shown to be at risk further detailed work will be undertaken to see if an improvement scheme can be justified on cost benefit grounds. If justification is available then the scheme is placed on the Long Term Needs Programme for future work.

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 needs. An investigation into possible improvements to the existing scheme for Horrabridge is included in the Medium Term Plan.

Shoreline Management Plans

Included within this plan area is the coast between Butchers Cove to the east and The Long Stone to the west. The Environment Agency, in partnership with local authorities, county

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councils and English Nature, are preparing two Shoreline Management Plans which include this stretch of coast. The two separate plans cover the coast east of Rame Head up to Dorset, and west of Rame Head to the Lizard.

The aims in producing the plans are to improve understanding of coastal processes, predict the likely future evolution of the coast, identify assets at risk and improve consultation between organisations with an interest in the shoreline. The plans will consider options and detail preferred approaches, recommend monitoring programmes and identify environmental enhancements. The plan to the east is being led by West Dorset District Council and is entering Stage 2 of the process. It will include parts of the Yealm and Tamar Estuary complexes. The plan to the west is being lead by Kerrier District Council and Stage 1 is due to start in 1996.

Issue 47 : The need to understand how the coastline is changing.

Action: To undertake studies so that Shoreline Management Plans can be produced showing the preferred approach for future management of the coastline. Each study will be carried out in the following stages.

Stage 1 Scoping Study

Stage 2 Detailed study of Coastal Interest and Coastal Processes

Stage 3 Consider options and detail Preferred Approach

Target: To identify where sea defence schemes are needed to determine where future development is unwise.

State: Both studies to the east and west of Rame Head are being progressed by consortiums of local authorities, county councils, English Nature and ourselves.

Managed Retreat

Managed retreat is the deliberate process of setting back a line of defence or allowing a coastline to recede to a new line of defence (natural or manmade) accompanied by measures to encourage the development of an environmentally beneficial habitat. There can be significant conservation gains from practicing managed retreat, notably the creation of habitat such as saltmarsh. The value has been recognised in the MAFF 'saltmarsh creation habitat scheme', where payments are made to landowners to allow conversion of land. Obviously not all sites are suitable, for managed retreat, some land or structures are too important or valuable not to be given protection.

In 1995 the defence at Blaxden Meadow on the Plym Estuary was breached by the NRA, in agreement with the National Trust, thus allowing the water to flood in and out of the meadow in a controlled fashion. This change in management seeks to recreate a saltmarsh habitat for plant species and estuary birds. There are a number of other flood embankments within the catchment where similar work may be considered. Each site however must be considered individually, in liaison with the landowner and other interested groups. A review of potential locations may be carried out in any conservation review undertaken if the Tamar Estuary is designated as a Special Area of Conservation, see 4.1.

Both the shoreline management plan and managed retreat are raised as objectives within the Tamar Estuaries Management Plan (Ref 7). We support their inclusion and will seek full involvement in the multi-agency approach that will be required in their implementation.

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Emergency Response

Absolute flood protection is not possible. Because of this we need to warn people when there is a danger of flooding. We have a strategy which details how the procedures operate and which we use to improve our emergency response.

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

State: In some locations the target is not being achieved. The most common reasons are a lack of lead time from the upstream river level sensor, a breakdown in or omission from the cascade system for disseminating warnings and an lack of instrumentation.

Issue 48: To provide accurate flood warning to enable emergency organisations to respond and to safeguard life and property.

Action: A study into the level of Service for Flood Warning is currently being carried out to determine whether the required standard is being met: it is expected to be completed in this study area by the end of 1997. The results will identify additions and other changes to the Flood Warning network. There is an ongoing programme of improvement to the system including new outstation sites and changes to warning cascades.

A new river level site at Newnham Bridge for Tory Brook warnings is proposed for 1996/7. Preliminary investigation into a site at Shaugh Bridge on the River Plym is also being undertaken.

Work on Flood Prediction Modelling is also currently proceeding and, depending on the results of the service levels study, could be extended into the Tamar Estuary and Tributaries area.

Target: The Environment Agency to take over role of warning the public and other organisations of likely flooding from the Devon and Cornwall Police on the 1 September 1996.

State: At present we issue warnings to the Police. The police then cascade the warning to the general public.

Issue 49: The need to provide the general public and other organisations with accurate flood warnings.

Action: We are developing communication systems to take over this role. These are aimed at improving the success rate in providing flood warnings to those members of the public most at risk.

Target: To operate Environment Agency flood defences to design standards. To prepare and keep up to date a plan for responding to flooding and damaged flood defence structures within specified time limits, depending on location and potential impacts. During a flood event our prime role is to ensure that the flood capacity of each river is maximised. This is achieved by actioning response levels A and B, defined as follows:

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- A Checking operational flood defence systems are working properly. This includes operating barriers, closure of flood gates, positioning stop logs, ensuring pumping stations are operating, adjusting sluice gates/ penstocks etc. ensuring flood storage areas are utilised properly.
- B Check river reaches to avoid obstruction of watercourses and monitor river levels. This includes clearance of trash screens, inspecting sensitive locations where blockages may occur, checking flood defences to ensure they are functioning properly, reporting on river levels to assist with flood warning.

State: Operational response to Levels A and B in this catchment would include the following:

- A Operation of lock gates at the Barbican, Plymouth and checks on the gates at Millbrook.
- B Clearance of screens in Millbrook, Horrabridge, Walkhampton and Plympton, checks on major river crossings throughout the catchment, inspection of flood defence schemes where warnings are in force, particularly at Yealmpton, Plympton, Horrabridge, Bathpool and Millbrook.

The appropriate action to take during a flood event is decided by the Area Base Controller who uses up to date telemetry information, radar data, experience and judgement of need considering the situation across the area and the available resources. The Base Controller's handbook contains specific information about flood defence schemes and sensitive locations in each catchment; this handbook needs updating.

Issue 50: Regular updating of the flood warning database and procedures

Action: The Base Controller's handbook is expected to be revised by the end of 1996.

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5.5 Waste Management

Target: Draw up national and regional strategies for the management of waste.

State: There is currently a draft strategy for Devon and a draft for Cornwall is in preparation but no regional strategy has yet been developed.

Planning for the management of waste is best undertaken looking at a large geographical area, as well as the needs of particular locations. For this reason there is a need to look at demand and supply beyond the boundary of this catchment. Key waste management decisions are required before the end of 1997/98 due to capacity running out at current facilities and the length of time required to plan, approve and start up new facilities.

Planning for waste management cascades from National to Regional to County to District level. Planning for waste management is undertaken by two distinct groups. First the Environment Agency who review current and future waste generation, and from this the size and types of management facilities which are required. Second the County Councils and Local Planning Authorities who are required to make provision for sufficient and adequate facilities.

There is a requirement on the Environment Agency to produce a regional strategy to outline the current and future needs for waste management. This work will be undertaken in two distinct phases, firstly data on current requirements will be collected in a waste arisings survey. The second stage is the production of the strategy.

County Councils and Local Planning Authorities will also be planning for their needs to have adequate facilities for the waste produced, which they are obliged to take for management and disposal. Devon and Cornwall County Councils are both producing draft waste strategies, for consultation in Autumn 1996 and Spring 1997 respectively. However they are not able to actually provide and run any facilities themselves. This must be done by a third party. For any third party to undertake the capital investment they must be sure of a return. Planning Authorities must therefore decide what level and type of facility they will be able to support, and is most sensibly planned at a regional level.

The undertaking of a waste management survey and production of a regional strategy will take place outside the forum of Local Environment Agency Plans such as this. Reporting however can be made in the Annual Updates, and once completed the strategy can inform the Plan process.

Issue 51: The need for a regional waste strategy.

Target: Reduce waste production in line with government guidelines.

State: In December 1995 the DoE produced the strategy for sustainable waste management based on a hierarchy of waste reduction, reuse, recovery and, lastly, disposal. In it they have set two primary targets; to reduce the proportion of controlled waste going to landfill to 60% by 2005 and to recover 40% of municipal waste by 2005. They have also made a commitment to a third target; by the end of 1998, to set a target for overall waste reduction. These primary targets are supported by a number of more detailed targets.

Instigation of recommendations has begun by some, within this catchment Plymouth City Council have started the process, see Section 4.1. Current levels of achievement by Local

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Planning Authorities (Audit Commission figures) for the recycling of domestic waste for 1994/95 are:

Caradon District Council - 4.9%

North Cornwall District Council - 5.2 %

Plymouth City Council - 9.5 %

South Hams District Council - 7.7 %

West Devon Borough Council - 9.8 %

Issue 52 : The need for reduction in waste production and the proportion going to landfill.

Target: Prevent the operation of waste disposal facilities having an adverse environmental impact.

State: Crowndale tip site has been identified as causing pollution of the River Tavy, see Page 92. There have been incidences of leachate escaping from the Chelston Meadow site. Action has been taken to correct the problem and we will continue monitoring. The presence of an old landfill tip, which pre-dated licensing, prevented a retail development in Plymouth due to fears of contamination. This is a problem which may well reoccur but is one we can only react to.

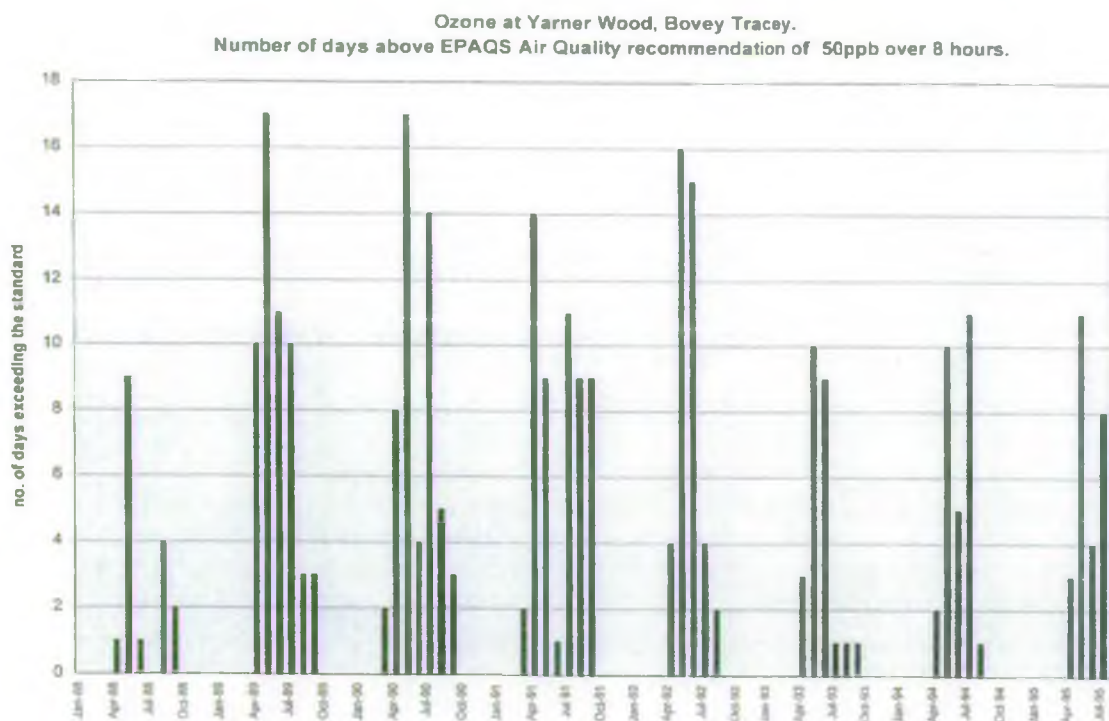
The operation of waste facilities involves transport, which itself has an environmental impact and one which should be taken into account when planning for waste management. It cannot however be adequately detailed in a plan such as this.

The disposal of sewage sludge to sea is to be stopped by 1998 under an EC Directive. This additional material will have to be disposed of by application to agricultural land, incineration, composting or landfill. Disposal to agricultural land is most likely to increase and there is the possibility of increased pollution associated with land runoff. The Environment Agency currently monitors the disposal of waste to agricultural land through a system of pre-notification before the waste is spread. In addition we are liaising with the Agricultural Development and Advisory Service (ADAS) to improve standards of landspreading and we promote the use of the Code of Good Agricultural Practice.

The introduction of the Government Landfill Tax in October 1996 is likely to have a significant impact on waste management. The charges made to landfill operators are likely to be passed on to their customers by raising the "gate fee". The principle behind the tax is to provide a financial incentive to waste producers to minimise the waste they produce or to use methods of disposal which have less of an environmental impact. It is possible that some waste producers will simply dispose of the waste at unauthorised sites to avoid the rise in costs. Illegal waste disposal activities can cause pollution and harm to wildlife, however and are treated very seriously by the Environment Agency. Regulation officers examine all such activities and enforcement action is taken where necessary. Within Cornwall there has been an increasing number of smaller operators giving up their licences.

There has also been an increase in the number of activities registered by us as exempt from waste licensing. The exemption system is a deregulation initiative designed to allow certain waste handling and disposal activities to proceed without the need for the complex licensing process. There are strict guidelines which must be adhered to and there must be no risk of pollution. Exempt operations are not subject to the costs involved with setting up a licensed waste management site and this has created an incentive for some individuals to try and abuse the system. The details of each exempt operation are carefully examined before being registered however and inspections are made to ensure that the regulations are not being broken.

Figure III Ground Level Ozone in the South West



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5.6 Air Quality

Ambient concentrations of smoke and sulphur dioxide have generally declined in the UK as a whole over the last 20 years. Similarly, both the quantity released and the concentration of lead in the atmosphere has declined since the mid 1980's following the introduction of lead free petrol. However, the release of some pollutants such as nitrogen oxides, carbon monoxide and volatile organic compounds have remained relatively stable during this period, although there may have been changes in their source. For example, releases of oxides of nitrogen from industrial sources have generally declined whilst emissions from road traffic have increased.

With the exception of ground level ozone, ambient levels of these pollutants are generally lower in the South West of England than in many other parts of England and Wales.

There are more than 400 ambient air quality monitoring sites dotted around the UK providing data to a central computer. An air quality information service is available on freephone telephone number 0800 556677. Information is also available on the Internet at <http://www.open.gov.uk/doe/doehome.htm>. and on Ceefax pages 404, 410-414, Teletext page 106.

The Environment Agency has published 'The Environment of England and Wales - a Snapshot' (Ref 44) which describes the state of the environment, including air, in the UK.

National Air Quality Strategy

Under Part 4 of the Environment Act 1995 the Government is required to publish a national strategy for air quality including:

- ▶ a framework of standards and objectives for the pollutants of most concern
- ▶ a timetable for achieving objectives
- ▶ the steps the Government is taking and the measures it expects others to take to see that objectives are met.

The strategy will be published for consultation in the summer of 1996. We will be working closely with local authorities to help achieve the objectives of the National Air Quality Strategy.

Local Air Quality Management Areas

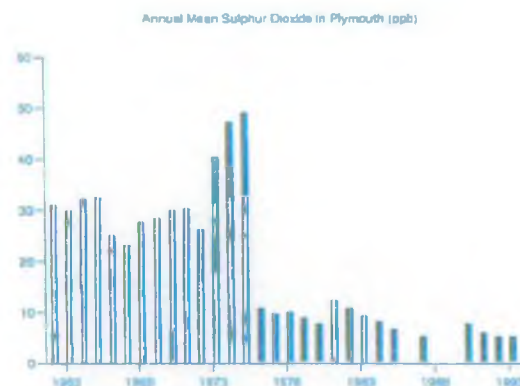
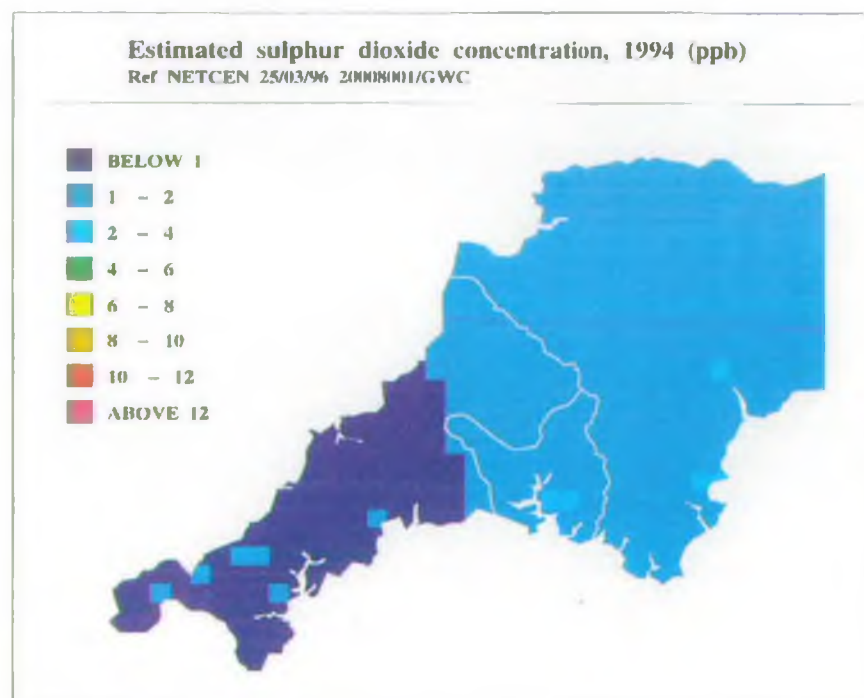
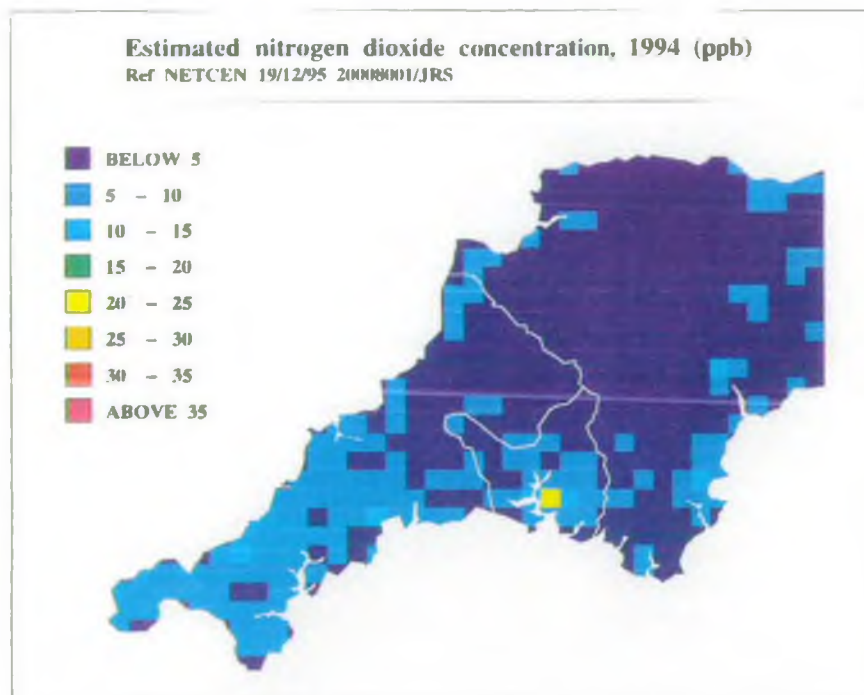
In due course air quality standards may be prescribed in regulations made by the Government and obligations placed on local authorities regarding the establishment and operation of local air quality management areas. Local authorities will have to carry out periodic reviews of air quality in their areas. As in the case of Plymouth City Council this may build on existing records and reports. Where standards are not being met or are not likely to be met they will make action plans to improve air quality in these areas.

A pilot study (one of 14 in the UK) will be taking place in Cornwall from 1996. Actions that come out of the pilot study, the Cornwall Air Quality Forum, may show the way forward to dealing with air quality issues in the area and region.

Ground Level Ozone

Ozone in the upper atmosphere shields the earth from harmful UV radiation. At ground level however, ozone can be a harmful pollutant damaging crops and building materials and causing respiratory difficulties amongst sensitive people. Ozone is not emitted directly from any man-made source in any significant quantities, but arises from complicated chemical reactions in the atmosphere driven by sunlight. In these reactions, oxides of nitrogen and hydrocarbons (derived mainly from vehicle exhausts) react in the atmosphere to produce ozone. These chemical

Figure IV Estimated nitrogen dioxide and sulphur dioxide concentrations 1994



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reactions do not take place instantaneously, but over several hours or even days, and once ozone is produced it may persist for several days. In consequence, ozone produced at one site may be carried for considerable distances in the air, and maximum concentrations usually occur away from the source of the primary pollutants. The highest concentrations of ozone generally occur during hot, sunny and relatively windless days in summer.

In common with other parts of Southern England, ozone levels in the catchment are generally above those at which damage to vegetation may occur (Ref 48). The Expert Panel of Air Quality Standards (EPAQS) recommend an Air Quality Standard for ozone in the UK of 50 parts per billion (ppb) as a running 8-hour average. Figure III shows the estimated number of days in the South West over which this recommendation would be exceeded and a histogram of measurements taken at Yarner Wood near Bovey Tracey.

The Department of Environment has published a UK strategy on the reduction of emissions that can produce ozone (Ref 49). Nationally the Environment Agency will have an input into the reduction of volatile organic compounds (VOCs) and oxides of nitrogen (NO_x), both of which are precursors in the formation of ground level ozone. VOC and NO_x releases from IPC processes are controlled by limits in authorisations. These limits will be reduced over time as operators move towards new plant standards.

Sulphur dioxide

Sulphur dioxide is toxic to plants and human health. An environmental quality criteria for effects on natural vegetation recommended by the World Health Organisation is 7.5ppb as an annual average. Human health effects are best gauged by reference to the recommended standard from EPAQS - 100ppb as a 15 minute average (there is no data from sites west of Bristol available as a 15 minute average). In common with other sites in the Department of the Environment's basic Urban Network in England and Wales the annual mean concentration of sulphur dioxide in Plymouth has fallen due to a reduction in the use of sulphur containing fuels in the area (See Figure IV).

Nitrogen dioxide

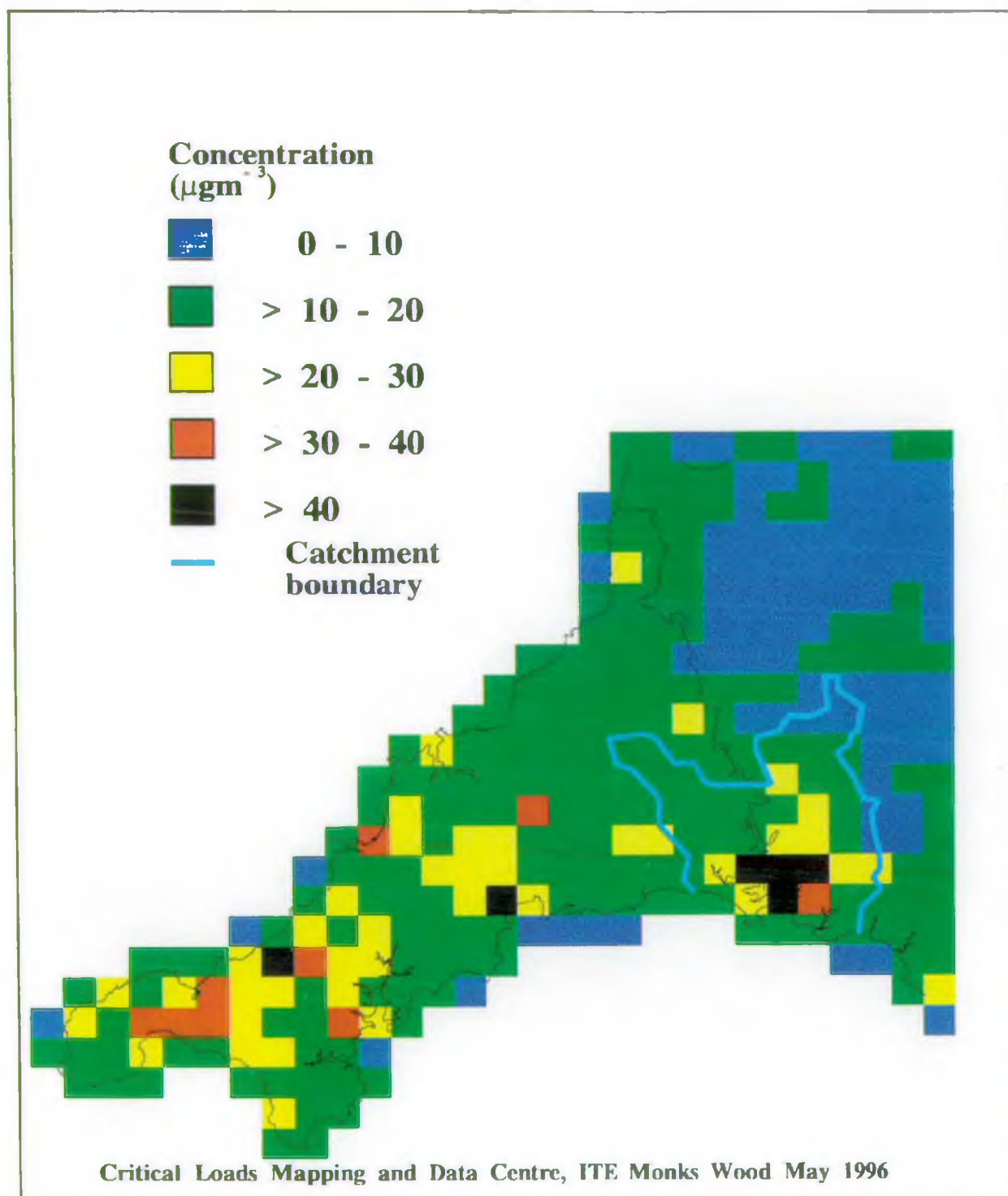
Nitrogen dioxide is also toxic to plants and humans. Concentrations are subject to an EC Directive (Ref 50) and should not exceed 104ppb for more than 175 hours per year (based on the 98th percentile of hourly averages). This is generally not exceeded if the annual mean is less than 40ppb and is therefore unlikely to be exceeded in the catchment (see Figure IV).

The World Health Organisation (WHO) and United Nations Economic Commission for Europe have recommended an air quality guideline of 30 micrograms/m³ (15.7 ppb) for effects of nitrogen oxides (NO₂ and NO) on vegetation. Figure V indicates that this value is exceeded in one or two localities.

A map based on national monitoring data is not able to indicate specific sources which might lead to local exceedances, for example, alongside busy roads or industrial sources. These could only be identified through local monitoring.

It is anticipated that the exceedences of air pollutants recorded within the area will be reviewed as part of national and local initiatives previously described.

Figure V **Estimated annual NO_x concentrations for 1994**



Data acknowledgement: AEA Technology

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Acid Rain

The term 'Acid Rain' is loosely used to describe wet or dry deposition of acidic compounds from the atmosphere. It is popularly used to mean rain, mist or snow which contains acid compounds predominantly of sulphur and nitrogen. The main sources of these acid gases are power stations and other large industrial combustion plant which burn fossil fuels (coal, oil and gas) and (particularly in the case of oxides of nitrogen) motor vehicles. Ammonia which arises from agriculture may under some soil conditions also lead to acidification. Natural sources of sulphur dioxide such as volcanoes and marine algae account for only a few percent (less than 5%) of the acid deposition received in the UK.

In some parts of the UK, natural ecosystems have a significant capacity to neutralise acidity and acid deposition has little impact on them, but in acid sensitive areas, acid rain causes damage to plants and soils in which they grow. In these areas substances can be released from soils which run-off into water bodies and are toxic to water life. Acid deposition can also alter the acid balance in water bodies and this too has an effect on the life they support; it can also corrode buildings. Acid rain components which contain nitrogen have the effect of acting as a fertilizer; this can change the make up of communities of land and water plants and affect animals that live on them.

In recent years there has been increasing interest in the development of effects based emission control policies and this has led to the development of the critical loads approach as a science based way of optimising air pollutant emission control strategies. The concept of a critical load is a simple one - it is the threshold at which the pollutant load causes harm to the environment and has been defined by the United Nations Economic Commission for Europe as:

- * a quantitative estimate of exposure to one or more pollutants below which significant harmful effects on sensitive elements of the environment do not occur according to present knowledge.

In the case of soils the critical load has been calculated on the basis of the rate of production of acid neutralising compounds a part of natural weathering. Different soils will weather at different rates and hence will be more or less sensitive to acid deposition. Rocks such as Dartmoor granite are relatively slow to weather and therefore are sensitive to acid deposition.

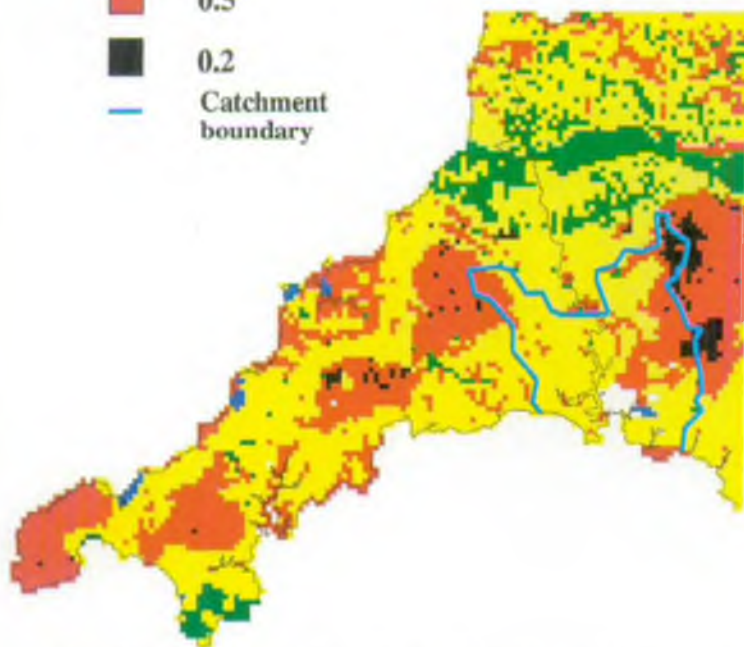
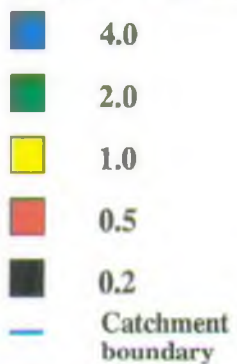
Figure VI shows the distribution of critical loads of acidity for soils and an estimate of the current deposition of sulphur calculated on a 20km grid. Where the deposition of acidifying compounds exceeds the critical load, the critical load is said to be 'exceeded'. Figure VII shows the exceedence of the critical loads for soil. As might be expected the critical loads are particularly exceeded over Dartmoor. In England and Wales, typically 49% of acid deposition arises from large combustion sources such as power stations or refineries, 32% from European sources, 11% domestic, other industry and natural sources 4-5% each. It is expected that action at a national level by the Agency will significantly reduce the input from the major UK combustion sources. Figure VII also shows the anticipated level of exceedence in 2005 once the controls announced in March 1996 on power station emissions have been fully implemented. By that time it is likely that European sources will be the largest contributor (40%) with large combustion sources and domestic emissions contributing approximately 25% each.

Critical load areas in the catchment on the uplands of Dartmoor are also shown on the Forestry Map (Map 8), where further planting of coniferous trees could exacerbate acidic conditions in the watercourses. However, the causes of acidity in these watercourses are thought to be due to the natural geology and soil of the area.

Figure VI Critical loads for acidity of soils and Non-marine sulphur deposition

Critical loads for acidity of soils for Cornwall

Critical Load
(keq H⁺ ha⁻¹ year⁻¹)

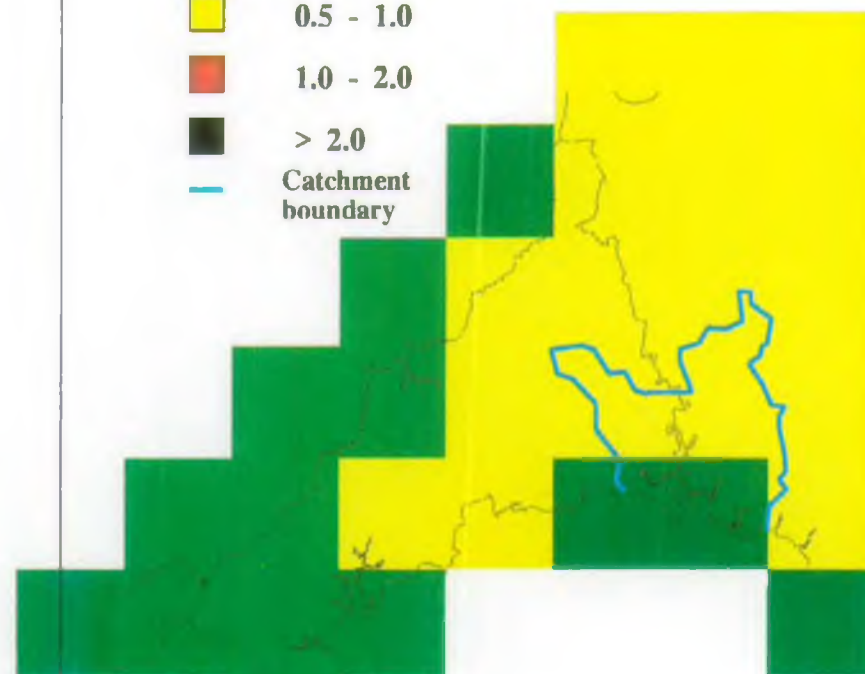


Critical Loads Mapping and Data Centre, ITE Monks Wood May 1996

Data acknowledgement: CLAG soils sub-group

Non marine sulphur deposition for 1989 - 1992

Deposition
(keq H⁺ ha⁻¹ year⁻¹)



Critical Loads Mapping and Data Centre, ITE Monks Wood May 1996

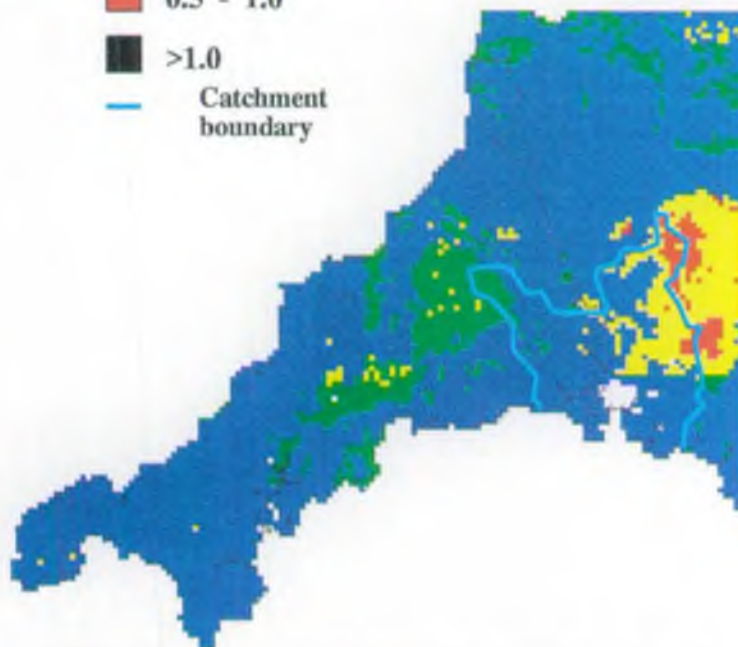
Data acknowledgement: AEA Technology

Figure VII Exceedences of critical load of acidity of soils, for 1989-92 and modelled for 2005

Exceedance of critical load for acidity of soils
by non-marine sulphur deposition 1989-92

Exceedance
($\text{keq H}^+ \text{ha}^{-1} \text{year}^{-1}$)

- Not Exceeded
- 0.0 - 0.2
- 0.2 - 0.5
- 0.5 - 1.0
- >1.0
- Catchment boundary



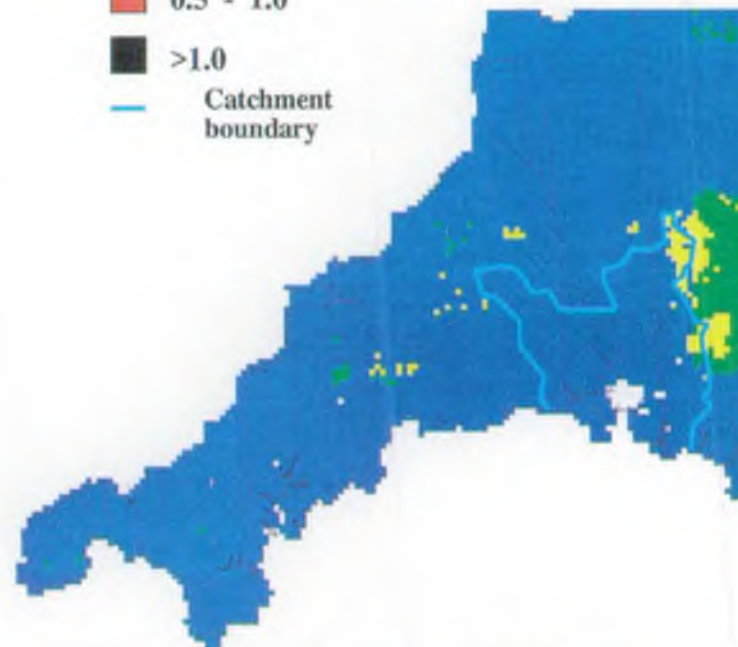
Critical Loads Mapping and Data Centre, ITE Monks Wood May 1996

Data acknowledgement: CLAG soils sub-group

Exceedance of critical load of acidity for soils
by HARM 7.2 modelled sulphur deposition for
2005

Exceedance
($\text{keq H}^+ \text{ha}^{-1} \text{year}^{-1}$)

- Not Exceeded
- 0.0 - 0.2
- 0.2 - 0.5
- 0.5 - 1.0
- >1.0
- Catchment boundary



Critical Loads Mapping and Data Centre, ITE Monks Wood May 1996

Data acknowledgement: CLAG soils sub-group, Hull University

6.0 SUMMARY TABLE OF ISSUES

The following tables are a summary of the issues which have been raised in the preceding State of the Catchment section, Section 5. Against each issue is given the page where that issue is raised and discussed in more detail. The options for action are our own suggestions with input from steering group members and some regular consultees.

We would like your views on the validity of each action and our suggested options for implementation.

No	Issue	Options for Action	Benefits	Constraints	Responsibility	
					Lead	Others
1	Effect of STWs on water quality					
	1 Marginal failure of RQO (due to BOD) in the River Yealm from below Ridgect Lake to Popples Bridge, probably caused by Lee Mill Industrial Estate STW and surface water drainage from industrial estate (page 92). Invertebrate communities at Popples Bridge impacted by organic enrichment or elevated pH (page 108).	<ul style="list-style-type: none"> * Enforcement of consent at Lee Mill Industrial Estate STW * Investigate impact from industrial estate 	All Issues <ul style="list-style-type: none"> * Achieve RQOs and environmental improvements 	All Issues <ul style="list-style-type: none"> * Cost 	EA	SWW
	2 Failure to comply with long term RQO (due to BOD and total ammonia) in the River Tavy from West Bridge to Below Crowndale STW and failure to meet the EC Freshwater Fish directive standard for total ammonia downstream of Crowndale STW (page 92).	<ul style="list-style-type: none"> * Additional investment may be required by SWW to improve Crowndale STW if studies being carried out by EA confirms that this STW contributes to exceedence of Directive standards 	<ul style="list-style-type: none"> * Compliance with EC Freshwater Fish Directive and environmental improvements * Compliance with long term RQO 		SWW	
	3 Failure to comply with long term RQO (due to BOD, total ammonia and unionised ammonia) in the Kelly Brook due to Callington STW (page 93).	<ul style="list-style-type: none"> * Additional investment required by SWW to improve Callington STW 	<ul style="list-style-type: none"> * Compliance with long term RQO 		SWW	

No	Issue	Options for Action	Benefits	Constraints	Responsibility	
					Lead	Others
1	4 Poor quality effluent from Brixton STW (page 107).	<ul style="list-style-type: none"> * Investigate occurrence of aesthetic pollution * Review consent * Additional investment required by SWW to improve Brixton STW 	* Environmental improvement	* Cost	EA	SWW
2	<p>Unknown sources of BOD (organic enrichment) affecting water quality, and organic enrichment/decreased pH impacting on invertebrate communities</p> <p>1 River Yealm from above Yealmpton STW to the Normal Tidal Limit failed to comply with its long term RQO due to elevated BOD (page 92). Invertebrate communities at Yealm Bridge impacted (page 108).</p> <p>2 River Tavy from Harford Bridge failed to comply with its long term RQO due to elevated BOD (page 92). Invertebrate communities at Hill Bridge and Harford Bridge impacted (page 108).</p>	<p>All issues</p> <ul style="list-style-type: none"> * Investigations to identify cause(s) 	<p>All issues</p> <ul style="list-style-type: none"> * Environmental improvements 	<p>All issues</p> <ul style="list-style-type: none"> * Cost 	All issues EA	

No	Issue	Options for Action	Benefits	Constraints	Responsibility	
					Lead	Others
2	3 Invertebrate communities on the Tamerton Foliot Stream impacted by organic enrichment (page 108).	All issues * Investigations to identify cause(s)	All issues * Environmental improvements	All issues * Cost	All issues EA	
	4 Invertebrate communities on the Haye Valley Stream impacted. (See Issue 1.3)					
3	Effect of storm sewer overflows on water quality Failure to comply with long term RQO (due to BOD and total ammonia) and aesthetic pollution in the River Tavy from West Bridge to below Crowndale STW and failure to meet EC Freshwater Fish directive standard for total ammonia downstream of Crowndale STW (page 92/3).	* SWW will be carrying out improvements to storm sewer overflows in Tavistock and at storm overflow at Tavistock STW	* Environmental improvements * Compliance with EC Freshwater Fish directive and long term RQO	* None known	SWW	EA

No	Issue	Options for Action	Benefits	Constraints	Responsibility	
					Lead	Others
4	Non-compliance with EC Bathing Water Directive standards (page 94) 1 Wembury 2 Plymouth Hoe East and West.	* Closely monitor new sewage treatment at Wembury for improvement * Improvement following completion of Plymouth Central Clean Sweep Scheme in 1998	Both Issues * Compliance with EC Bathing Waters Directive and environmental improvements	Both Issues * Cost	EA SWW	SWW
5	Exceedance of EQS for tributyltin in the River Yealm downstream of the discharge from International Paints (page 97).	* Investigations to identify sources * Review discharge consent	Both Options * Compliance with EQS and environmental improvement	* Cost	EA	
6	Low pH and elevated zinc concentrations downstream of china clay works (page 99) and the impact of china clay discharges on invertebrate communities (page 108).	* Investigations to identify sources * Seek derogation if causes are natural	* Compliance with EQS * Protects other determinands at a higher level	* Cost * None known	EA EA	
7	Exceedance of copper and zinc EQSs downstream of Crowndale and Ernesettle STWs (page 99).	* Investigations to identify sources * Review discharge consent	* Compliance with EQS and environmental improvement	* Cost	EA	

No	Issue	Options for Action	Benefits	Constraints	Responsibility	
					Lead	Others
8	Determine whether the Lynher Estuary is a sensitive area under the UWWTD (page 101).	<ul style="list-style-type: none"> * Monitoring to determine trophic state of Lynher Estuary * Identify principal sources of nutrients to estuary 	Both options <ul style="list-style-type: none"> * Environmental improvement * Compliance with UWWTD 	Both options <ul style="list-style-type: none"> * Cost 	EA	SWW
9	Oxygen sags in Upper Tamar Estuary -leading to fish deaths (page 110).	<ul style="list-style-type: none"> * Investigation to determine causes * Monitoring estuarine water in exceptionally dry weather * Review methods to improve oxygenation of estuarine water * Use of a Roadford fisheries water bank release to encourage salmonid migration into freshwater 	<ul style="list-style-type: none"> * Protection of sensitive wildlife and their habitat * Increased survival of adult salmonids 	<ul style="list-style-type: none"> * Cost 	EA	
10	Operation and management of public water supply during droughts (page 116).	<ul style="list-style-type: none"> * Intake and distribution system improvements * Develop water conservation controls for a drought 	<ul style="list-style-type: none"> * Make full use of licenced resource * Prevent adverse environmental impact 	<ul style="list-style-type: none"> * Cost 	SWW/ EA	

No	Issue	Options for Action	Benefits	Constraints	Responsibility	
					Lead	Others
11	Meeting future public water supply demand (page 118).	<ul style="list-style-type: none"> * Modelling of the Roadford and Colliford Strategic Supply System to determine the yield, best use of available resources and future developments. * Encourage demand management and leakage control * Review of reservoir operating rules. 	<p>All options for action:</p> <ul style="list-style-type: none"> * Efficient use of water resources. * Improved water environment/fishery 	<p>All options for action:</p> <ul style="list-style-type: none"> * Resources * Co-operation of the water Company 	SWW/ EA SWW/ EA	
12	Effects of abstraction on salmonids in the River Tavy (page 120). 12A Need to establish level of impact	<ul style="list-style-type: none"> * Alleviation of Low Flow study fish surveys to help recommend protective conditions on NP abstractions at Tavy Cleave, Hillbridge and Abbey Weir 	<ul style="list-style-type: none"> * Potential improvement in salmonid migration within freshwater Tavy 	<ul style="list-style-type: none"> * Adequacy of data * Cooperation of National Power (NP) * Resources 	EA	NP
	12B Lopwell dam an obstacle to salmonid migration	<ul style="list-style-type: none"> * Install fish counter at Lopwell 	<ul style="list-style-type: none"> * Better data and understanding of impact of Lopwell abstraction 	<ul style="list-style-type: none"> * Resources 	EA	SWW
		<ul style="list-style-type: none"> * Modification of fish pass - concentrate residual flows 	<ul style="list-style-type: none"> * Improved salmonid migration into freshwater 	<ul style="list-style-type: none"> * Resources * Potential impact on Lopwell abstraction * Cooperation of SWW and NP 	EA	SWW NP

No	Issue	Options for Action	Benefits	Constraints	Responsibility	
					Lead	Others
12	12C Reduced Salmonid habitat.	* PHABSIM used as a tool to show impact of abstraction on habitat	* Better understanding of the impact of abstraction on salmonid habitats and possible basis for setting protective conditions on NP abstractions.	* Resources * Cooperation of NP- need to protect leats	EA	NP
13	Unatural flow regimes affecting angling conditions on the River Tavy (page 120).	* River Diaries Initiative to help identify acceptable conditions for angling	* Help illustrate potential impact on angling	* Cooperation of anglers/ riparian owners	EA	Anglers/ Riparian Owners
14	The need to balance flows between the River Tavy and hydropower abstractions (page 120)					
	14A Seek to protect viability of power station	* Identify and agree an operational regime acceptable to both river and requirements of power stations	* Protection of river from damaging low flows * Protection of historic leats * Future viability of power stations	* NFFO Agreement * Co-operation of NP	EA	NP/ WDBC/ TTC/ DNP
	14B Establish acceptable conditions in Tavistock-Morwellham Canal	* Investigations to determine minimum acceptable conditions	* Maintain amenity value of canal and ecology * Protection of river from damaging low flows	* Resources * NFFO Agreement	EA	NP/ WDBC/ TTC
	14C Control abstraction into the Tavistock-Morwellham Canal	* Monitor abstraction * Produce Operating Agreement	* Public accountability * Best use of existing resources	* Site conditions * Technology	NP	EA

No	Issue	Options for Action	Benefits	Constraints	Responsibility	
					Lead	Others
15	Deprived reach below Tavistock Fish Farm abstraction (page 121).	<ul style="list-style-type: none"> * Measure impact of abstraction * Discuss operation of fish farm abstraction when changes are made to NP abstractions 	<ul style="list-style-type: none"> * Benefits of changes to operation of Mary Tavy Power Station are transmitted to the deprived reach below fish farm * Water quality and environmental improvements 	<ul style="list-style-type: none"> * Resources * Cooperation of fish farmer 	EA	fish farmer
16	The need to review priority of low flow sites in the catchment (page 121).	<ul style="list-style-type: none"> * Use current methodology to rank the low flow investigations 	<ul style="list-style-type: none"> * Clear priority for action 	<ul style="list-style-type: none"> * Resources * Data adequacy 	EA	
17	The need to protect and enhance the riparian strip (page 123).	<ul style="list-style-type: none"> * EA works carried out to Best Practice. * Encourage landowners to protect riparian strip. * Restoration/ replanting. 	All Options <ul style="list-style-type: none"> * Improved water environment for wildlife/fisheries * Reduce bank erosion * improve quality of surface water run off 	All options <ul style="list-style-type: none"> * Cost * Potential loss of flood storage capacity. 	EA EA EA	land owners, conservation bodies MAFF, NFU

No	Issue	Options for Action	Benefits	Constraints	Responsibility	
					Lead	Others
18	Develop the protection of existing wetlands and actively seek opportunities to recreate wetland habitats (page 123)	* Support and promote the use of schemes such as Countryside Stewardship Schemes to encourage landowners to preserve habitats and/or recreate them	* Financial help to create habitats.	* Need to inform landowners of grants.	EA	CoCom/ EN/Land owners
		* Protection through the planning process	* Strong level of control where permission required.	* Requires monitoring	EA	Planning Authority
		* Advice from EA and other bodies to be given to landowners.	* Low cost.	* No direct financial incentives for landowners.	EA	EN/ NFU/ FWAG/ CoCom/ CWT/DWT
19	Loss of wetland and potential impacts on river flow regimes (page 123).	* Investigations to determine impacts	* Environmental improvements	* Resources	EA	other bodies
20	Perceived impact of development on ground and surface waters in Plymouth (page 124).	* Promote infiltration in new developments	* Environmental improvement	* Resources	EA	Developers
		* Surveying to model current flow conditions * Install check weirs below Efford Marshes	* Maintain water levels in Marsh	* Resources	EA/ Plymouth CC	
21	The need to identify key species and habitat requirements for SAC and SPA (page 125).	* Carry out baseline survey of resource * Support measures within TECF plan	* Set definite objectives for future management	* Await designation * Cost	EN/ EA/ DSFC/ CWT/ DWT/ RSPB/TECF	

No	Issue	Options for Action	Benefits	Constraints	Responsibility	
					Lead	Others
22	The need to develop and deliver biodiversity actions (page 126).	<ul style="list-style-type: none"> * Prioritise habitats and species * Implement relevant actions in existing biodiversity action plans * Develop biodiversity action plans for habitats and species requiring them 	All options: <ul style="list-style-type: none"> * Maintenance and enhancement of habitats and species * Target and integrate internal and external funds and resources 	All options: <ul style="list-style-type: none"> * Cost 	EA to lead on water related, such as rivers and streams, floodplains, otter, water vole and Atlantic salmon	Conservation groups, Government and voluntary bodies, landowners, general public
23	Unsuitability or lack of spawning gravels reducing salmonid production (page 131). 23A Continued monitoring of areas of improvement for maintenance purposes. 23B Access to and lack of spawning gravels. 1) Below Burrator dam 2) R Tavy from Tavy Cleeve to Coffin Wood 23C Assessment and rehabilitation of available gravels in suspected problem areas on Plym, Yealm and Lynher.	<ul style="list-style-type: none"> * Monitoring fish populations by use of fish surveys * Importation of spawning gravel * (2) Check passability of weirs * Remedial work where necessary 	<ul style="list-style-type: none"> * Establish success of work and benefit of expenditure * Increased available spawning habitat * Increased spawning area 	All actions <ul style="list-style-type: none"> * Resources 	EA EA EA	

No	Issue	Options for Action	Benefits	Constraints	Responsibility	
					Lead	Others
23	23D Excessive aquatic weed growth at Trewint Works	<ul style="list-style-type: none"> * Assessment of remedial work and its environmental impact * Removal of weed 	Both options: <ul style="list-style-type: none"> * Increase spawning habitat and optimize the fishery 	<ul style="list-style-type: none"> * Resources 	EA	
24	Inappropriate construction and location of instream structures (page 131).	<ul style="list-style-type: none"> * Draw up protocol of best practice for positioning and construction 	<ul style="list-style-type: none"> * Prevent adverse impacts and minimise need for maintenance 	<ul style="list-style-type: none"> * Cost 	EA	
25	Obstructions to fish migration requiring improvement or maintenance (page 133).	<ul style="list-style-type: none"> * Determine possible fish passes or by-pass channels * Complete survey of manmade obstructions/ weirs on River Yealm * Maintain River Tavy weirs * Removal of blocking trash dams and trimming of overhanging trees preventing passage of fish or impacting spawning gravel 	All Options <ul style="list-style-type: none"> * Improved access for migratory fish 	All Options <ul style="list-style-type: none"> * Cost 	EA	
26	Loss of salmonids at abstraction points (page 133).	<ul style="list-style-type: none"> * Review abstraction arrangements 	<ul style="list-style-type: none"> * Possible net gain of trout to River Plym 	<ul style="list-style-type: none"> * Cost * Goodwill of abstractors 	EA	
27	Rod catches lower than expectations on the Rivers Tavy, Plym, Lynher and Yealm (page 133).	<ul style="list-style-type: none"> * Investigate whether this is due to reduced salmon numbers * Protection of salmon from nets 	Both options: <ul style="list-style-type: none"> * Improved management decisions to increase salmon population to previous levels 	Both options: <ul style="list-style-type: none"> * Cost 	EA	

No	Issue	Options for Action	Benefits	Constraints	Responsibility	
					Lead	Others
28	Decline in catch of multi sea winter salmon (including spring salmon) and sea trout (page 134).	<ul style="list-style-type: none"> * Assist in a National EA investigation into decline * Continue monitoring; fish scale analysis / rod and net catches * Investigate possible byelaws to increase escapement of multi sea winter fish 	<ul style="list-style-type: none"> * Provide basis for decision making * Provide data to assist with decision making * Promote spawning of multi sea winter fish 	<ul style="list-style-type: none"> * Cost * Cost * Economic implication for users 	EA EA EA	MAFF MAFF/ Riparian interests/ Fishing clubs
29	Insufficient age class data for adult salmon and sea trout particularly on the Rivers Plym Yealm, and Lynher (page 134).	<ul style="list-style-type: none"> * Further scale reading to investigate adult population trends in stock abundance 	<ul style="list-style-type: none"> * Provide data for decision making and management strategies 	<ul style="list-style-type: none"> * Cost 	EA	
30	Insufficient knowledge of eel populations to enable sustainable management (page 134).	<ul style="list-style-type: none"> * Collect data in routine surveys * Bioaccumulation study of eel tissue 	<ul style="list-style-type: none"> * Enhanced knowledge of population 	<ul style="list-style-type: none"> * Cost 	EA	
31	Illegal exploitation of salmonids and juvenile bass (page 134).	<ul style="list-style-type: none"> * Rigorous and high profile enforcement 	<ul style="list-style-type: none"> * Protect stocks. 	<ul style="list-style-type: none"> * Cost 	EA	MAFF
32	Loss of income due to rod licence evasion (page 134).	<ul style="list-style-type: none"> * Greater publicity and enforcement 	<ul style="list-style-type: none"> * Ability to fund fisheries work 	<ul style="list-style-type: none"> * Resources 	EA	

No	Issue	Options for Action	Benefits	Constraints	Responsibility	
					Lead	Others
33	The need for a review of sea fisheries byelaws and increased publicity of fisheries regulations in the Tamar Estuary (page 135).	<ul style="list-style-type: none"> * Undertake review of Byelaws * Publicity 	<ul style="list-style-type: none"> * Integrated protection of fishery 	<ul style="list-style-type: none"> * Resources 	EA/ DSFC/ MAFF/ TECF	
34	Natural predation of fish stocks (page 135).	<ul style="list-style-type: none"> * Data to be collected to analyse scale of impact 	<ul style="list-style-type: none"> * Fulfill EA policy 	<ul style="list-style-type: none"> * Cost * Disagreement between users 	Riparian owners/ Fishing clubs	
35	Introduction of non-native fish species into freshwater and the marine environment (page 135).	<ul style="list-style-type: none"> * Update database on distribution of non-native species within still water fisheries. * Regular inspections of still water fisheries. * Monitoring of non-native escapees recorded during fisheries work. 	<ul style="list-style-type: none"> * Provide data for decision making. * Reduce illegal non-native introductions. * Provide data for decision making. 	All Options: <ul style="list-style-type: none"> * Cost 	EA EA EA	
36	Protection of endangered fish species and their spawning habitat (page 136).	<ul style="list-style-type: none"> * Notification to netsmen with their net licences of protected and nationally rare fish species * Further study and observational records of these species * Specific monitoring of these species 	All options: <ul style="list-style-type: none"> * Improved knowledge of the distribution and spawning of rare fish species to aid management decisions 	All options: <ul style="list-style-type: none"> * Cost 	EA EA MAFF/ DSFC/ EN	 netsmen EA

No	Issue	Options for Action	Benefits	Constraints	Responsibility	
					Lead	Others
37	General decline in the mollusc community (particularly bivalves) at monitored sites (page 136).	* Further investigation to determine whether impact of organic pollution or sampling effect	* Environmental improvement	* Cost	EA	
38	Effect on macroinvertebrates of organic enrichment in the vicinity of Devonport Dockyard (page 136).	* Further investigation to determine whether impact of organic pollution or sampling effect	* Environmental improvement	* Cost	EA	DML SWW
39	Assess the extent and impact of invasive species (page 137).	<ul style="list-style-type: none"> * Assess extent and impact on EA owned land and draw up appropriate programmes for treatment according to EA 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 * Prevent impact on riverside access for recreation or maintenance 	<ul style="list-style-type: none"> * Cost * Cost * Willingness of land owners to carry out appropriate action 	EA EA Conservation bodies	Land owners FWAG/ MAFF/LPAs
40	The need for assessment of the historic environment of the whole catchment (page 138).	<ul style="list-style-type: none"> * Undertake Assessment of water related resource. * Undertake general archaeological assesment. * Liaison with relevant external groups. * Support TECF plan initiatives 	<ul style="list-style-type: none"> * Ensure full consideration of archaeological sites in EA work * Ensure adequate protection 	* Resources	All options: EA/LPAs/ TECF/DAU/ CAU/English Heritage	

No	Issue	Options for Action	Benefits	Constraints	Responsibility	
					Lead	Others
41	To assist in the development of the numerous recreation issues brought to light in the 1994 survey and 'Tamar 2000', wherever we are able (page 139).	<ul style="list-style-type: none"> * Support the development and implementation of issues in the TECF plan * Fund work 	Both options <ul style="list-style-type: none"> * To ensure that EA duties to recreation are achieved 	Both options <ul style="list-style-type: none"> * Resources 	EA/TECF/PPMLC	BCU/ other recreation bodies
42	Environmental impact at heavily used recreational sites in the freshwater system (page 139).	<ul style="list-style-type: none"> * Support initiatives by other bodies * Fund work 	Both options <ul style="list-style-type: none"> * Achieve sustainable recreation at heavily used sites * Expand the recreational resource of the catchment 	<ul style="list-style-type: none"> * Resources * Incentives to landowners 	Dependant on locality	DNP/ EA/ NT/ land owners
43	The need for a fully integrated Flood Defence Management Manual and supporting System (page 140).	<ul style="list-style-type: none"> * Develop system 	<ul style="list-style-type: none"> * Improved targetting of resources to areas of greatest needs 	<ul style="list-style-type: none"> * Disruption in implementing change. 	EA	
44	Identification of flood risk to Planning Authorities. This should take account of the timetable for preparing district wide Local Plan(s) (page 141).	<ul style="list-style-type: none"> * EA 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 	EA	LPAs
45	Flooding downstream from existing and new development (page 141).	<ul style="list-style-type: none"> * Plan development to prevent flooding 	<ul style="list-style-type: none"> * No additional flooding problems 	<ul style="list-style-type: none"> * None known 	District Councils	EA/ Developer

No	Issue	Options for Action	Benefits	Constraints	Responsibility	
					Lead	Others
46	Need to update EA database of flood risk locations for potential capital works (page 142).	* Section 105 survey of catchment.	* Updated information on flooding problems	* None known	EA	
47	The need to understand how the coastline is changing (page 143).	* Undertake Shoreline Management Plans	* Better planning of defence strategies	* Resources	2 coastal groups chaired by South Hams DC and Kerrier DC	TECF
48	To provide accurate flood warning to enable emergency organisations to respond and to safeguard life and property (page 144).	* Continue to develop and maintain a flood warning system	* Minimise impact of flooding	* Resources	EA	
49	The need to provide the general public and other organisations with accurate flood warnings (page 144).	* Develop communications system	* Minimise impact of flooding	* Resources	EA	
50	Regular updating of the flood warning database and procedures (page 145).	* Flood Warning Levels of Service study	* Improved flood warning	* None known	EA	
51	The need for a regional waste strategy (page 146).	* Undertake waste arisings survey * Draw up strategy	* Data needed to develop strategy * Adequate planning for future management of waste	* Resources * Resources	EA EA	County Councils County Councils

No	Issue	Options for Action	Benefits	Constraints	Responsibility	
					Lead	Others
52	The need for reduction in waste production and the proportion going to landfill (page 147).	* Develop recycling facilities	* Environmental improvements	* Resources	County Councils/ LPAs	

APPENDIX A

SSSI Designations

The 32 SSSIs within the catchment can be grouped as follows:

Tamar - Tavy Estuary, Lynher Estuary and St. John's Lake SSSIs are designated as large intertidal systems, with extensive mudflats. Significant numbers of waterfowl are attracted here during wintertime, spring and autumn migration. The estuary is the fourth most important in Great Britain for its wintering Avocet population, for example. Another feature of the high marine biological interest here is the wide range of invertebrate groups and species found in the sediments, which reflects the wide range of salinity within the system. The only known British population of Triangular Club-rush occurs here.

North Dartmoor and South Dartmoor SSSIs constitute part of the largest semi-natural upland in southern Britain. Important blanket bogs, mires and upland breeding birds occur here.

Park Wood, Grenofen Wood and West Down, Shaugh Prior Woods, Dendles Wood and Sampford Spiney comprise steep, rocky valleys clothed with ancient oak woodland. Alder carr and associated wetlands occur on the flatter valley floors. The watercourses are important for Otters and Dippers and usually support a rich moss and liverwort community, while the adjacent trees have a rich lichen flora.

Whitchurch Down contains an unusually herb-rich valley mire, supporting a wide diversity of invertebrates, including some rarities.

Sylvia's Meadow is a species-rich neutral/slightly acid unimproved grassland, one of only two comparable sites in Cornwall.

Lydford Railway Ponds is a small wetland on former railway land that supports a very rich dragonfly community, including three scarce species.

Billacombe is a small, species-rich neutral grassland that supports a population of the nationally rare plant Field Eryngo.

Eglarooze Cliff is a scrub-dominated coastal cliff supporting several rare plants and mosses.

Wembury Point is a coastal site of interest due to its extensive reef, intertidal habitats and cliffside scrub and grassland. A diversity of resident and migrant birds occurs here, including the rare Cirl Bunting.

Plymbridge Lane and Estover Road is a site of the Red Data-listed Plymouth Pear.

The remaining fifteen SSSIs - **Bull Cove, Viverdon Quarry, Devon Great Consols, Lockridge Mine, Wheal Emily, Burrator Quarries, Pitts Cleave, Devon United Mine, Wallsend Industrial Estate, Western King, South Brentor Quarry, Faraday Road, Mount Wise, Richmond Walk and Kingsand to Sandway Point** - are listed primarily for a wide range of significant geological reasons, although a few have biological interest as well.

APPENDIX A

CORNWALL NATURE CONSERVATION SITES

CWT Ref.	Site Name	NGR
CN 3.1	Rame Head	SX 41 50 - 43 50
CN 3.2	Tregantle Cliff & Trethill Cliff	SX 36 53 - 41 50
CN 3.3	Eglarooze & Battern Cliffs	SX 33 53
CN 6.1	St John's lake	SX 41 54 - 44 53
CN 6.2	Kingsmill Creek	SX 41 62 - 45 59
CN 6.3	Cargreen to Cross Park Wood	SX 40 64 - 43 62
CN 6.4	Pentillie Estate Woods	SX 38 66 - 41 64
CN 6.5	Cotehele Woods	SX 41 65 - 43 68
CN 6.7	Hare Wood	SX 43 71 - 44 69
CN 6.8	Clitter's Wood	SX 41 72 - 43 72
CN/NC 7 S14	Twelve Mens Moor	SX 25 73
CN/NC 7 S15	Craddock Moor & Witheybrook Marsh	SX 25 72
CN/NC S16	Caradon Hill	SX 27 70
CN/NC 8	Kit Hill	SX 37 71
CN 9.1	Lower Lynher Estuary	SX 34 57 - 41 57
CN 9.2	Notter Bridge Section	SX 37 57 - 38 60
CN 9.3	The Lower Tiddy	SX 34 59 - 36 57
CN 9.4	Pillaton to Newbridge	SX 36 64 - 34 67
CN 9.5	Newbridge to Fillamore	SX 34 68 - 30 69
CN 9.8	Caradon Wood	SX 30 71
CN 9.9	Modlien Woods	SX 37 62
CN 9.10	Rose Wood	SX 36 63
CN 9.11	Tregonett Wood	SX 32 70
CN 10.1	Pathada Woods	SX 32 62
CN 10.2	Cutkive and Hay Woods	SX 28 67 - 29 67
CN 10.3	West Down & North Park Woods	SX 297 660
CN 10.4	Heskyn Wood	SX 337 596
CN 10.5	Oliver's Coppice & Milldown Woods	SX 297 650
CN 16	Tincombe Reserve	SX 416 588
CN 19	Sylvia's Meadow	SX 413 708
CN 21	Blackley Wood	SX 32 66
CN 22	Blind Wood	SX 301 648
CN 23	Broadmoor and Ball Woods	SX 40 60
CN 25	Dwellamill Wood	SX 300 714
CN 26	Goodmerry Woods	SX 33 64
CN 31	Island Wood	SX 329 597
CN 32	Lambest Wood	SX 300 640
CN 34	Long Wood	SX 310 725
CN 36	Penharget and Common Woods	SX 306 706
CN 42	Leigh Hill to Ladypark Woods	SX 34 64
CN 43	Clarrick and Pigshill Woods	SX 44 52
CN 44	Lanjore Woods	SX 336 591
CN 45	Pidgerton Wood	SX 34 69
CN 47	Villaton Wood	SX 38 62 - 39 62
NC/CN 9.6	Rillamill to Bathpool	
NC 9.7	Upper Lynher	

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Analysis of River Lynher rod and net catches

Scales analysed from Lynher rod caught salmon (1970-1972) revealed adult salmon of between three and five years of age (freshwater and sea age combined). 90% of the salmon caught had smolted after two years in freshwater. The remainder had spent either one or three years in freshwater. The only previous spawners (total = 3) were found in the Lynher net catch in 1972 (sample size: 105 scaled salmon). Grilse (1SW) and 2SW fish form the majority of the returning salmon.

In the 1982, 1990 and 1993 surveys brown trout were found up to a maximum age of five years from scales that were readable.

During the 1990 and 1993 surveys sea trout were found of between two and eight years of age (freshwater and sea age combined). 48% to 61% of the sea trout caught during the above surveys (from a total of 49 scaled sea trout) had spent two years in freshwater, the remainder three years. The percentage of previously spawned sea trout varied between 41% (1993 - from a total of 29 fish) and 46% (1990 - from a total of 24 fish). In 1990 a sea trout with five previous spawning marks was recorded. No evidence of trends in abundance of adult sea trout can be determined from the limited data set of scaled sea trout currently available.

Analysis of historic Lynher electric-fishing surveys

Upper Lynher (upstream of Trebartha): Historically juvenile salmon densities are low above Trebartha with the upstream migration limit varying annually between Trebartha in 1980 (SX 2639 7795) and Tregirls in 1982 (SX 2218 7984). Upstream of Trebartha there is clear evidence of regularly successful sea trout and brown trout spawning, with particularly high densities evident in 1982. The fine gravels present at the higher survey sites are well utilised by the sea and brown trout population.

Main Lynher (downstream of Trebartha): Surveys in 1990 and 1993 showed good densities of salmon fry at most of the main river sites. Higher densities however are possible as shown in 1982. Lower salmon fry production was found at Stara bridge and Rilla Mill. Salmon parr production is moderate and quite even throughout the Lynher. Improved parr production in 1982 was evident between Knighton and Bathpool.

Trout fry are found throughout the main river at fairly low abundance levels. Moderate trout parr densities in the Lynher are spread throughout the main river with higher levels above Trebartha.

Withey Brook: The Withey brook rises either side of Smallacoombe Downs, flowing down a moderate gradient. However near to its confluence with the Lynher at Trebartha (SX 261 772) it flows through a wooded valley with a gradient of 100m/km at the steepest point. Salmon, sea trout, bullheads and brook lamprey have not been recorded upstream of this point. Brown trout and eels are found further up the Withey brook with very good trout parr densities suggesting a non-migratory population.

Darleyford stream: Surveyed in 1981 (SX 270/290 730/735) this small tributary that contained high copper levels was found to be fishless.

Caddapit stream: This small tributary was surveyed in 1980 at Caddapit (SX 340 689). Juvenile salmon, trout fry and bullheads were absent. Trout parr were present in low numbers.

Deans Brook: Two salmon year classes were present in fairly low numbers in 1990 when the Deans bridge site was last surveyed. A good trout population was present.

Tiddy brook: Small numbers of salmon breed annually on the Tiddy brook, spawning in the higher reaches. Results for 1993 however, were poor in salmon fry abundance throughout. Since the first Tiddy brook survey in 1980, salmon parr have always been found in low densities or absent from a site. In contrast trout fry numbers were excellent at the highest sites with good results from the last three surveys (1984, 1990 and 1993). Densities of trout parr are the highest within the Lynher catchment at two Tiddy sites suggesting good trout production during previous years.

Hay lake stream: One salmon fry and one salmon parr were caught at Tilland (SX 333 620) in the 1990 survey. The trout fry density was low. Numbers of trout parr were good.

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Analysis of historic lower Tamar electric-fishing surveys

Danescombe Stream

Although salmon were not recorded on this stream a substantial trout population exists with high densities of trout fry and trout parr. Eels were also present.

St Dominic Stream

The installation of a fish pass at Morden weir has aided the upstream migration of salmonids. However there is still no evidence of salmon spawning upstream of this weir. High densities of trout parr were found upstream of the weir in 1993 although trout fry production was lower than anticipated. Eels were also present.

Analysis of rod and net catches on the River Tavy

Rod caught salmon: Scales analysed from Tavy rod caught salmon (1970-1972, 1985-1988) revealed adult salmon of between two (1.1+) and five (2.3+, 3.2+, 2.1.1 sm.1) years of age (freshwater and sea age combined). Over 90% of the salmon caught had smolted after two years in freshwater. The remainder had spent either one or three years in freshwater. Only one fish from 264 scaled salmon caught by angling within the Tavy system had a previous spawning mark. In the early seventies small summer fish (.2+ fish) and grilse were numerically the most important groups of returning salmon. Data from the late eighties show that grilse are now the most important group of returning salmon with considerably reduced numbers of 2SW salmon.

Net caught salmon: Scales analysed from Tavy net caught salmon (1970-1972, 1977-1978) revealed adult salmon of between two (1.1+) and six years of age (2.4). Between 86% (from a total of 210 fish in 1972) and 96% (from a total of 530 fish in 1971) had smolted after two years in freshwater. The remainder had spent one or three years in freshwater. In 1970-1972 and 1977-1978 previous spawners with one spawning mark were rare (at most 2.3% of the fish caught). One exceptional salmon caught in 1970 had two previous spawning marks. In the early seventies small summer fish (.2+) and grilse were numerically the most important groups of returning salmon. Scale sampling the current netted salmon stocks should confirm the decline in abundance of 2SW salmon evident from the rod fishery.

In the 1983, 1985, 1989, 1992-1995 fish surveys brown trout were found up to a maximum age of seven years from scales that were readable.

Rod caught sea trout: During 1986 and 1987 rod caught Tavy sea trout were found of between two and seven years of age (freshwater and sea age combined). 65% of the sea trout caught (from a total of 197 scaled fish) had spent two years in freshwater, the remainder three years. The percentage of previously spawned sea trout varied between 23% (1986 - from a total of 87 fish) and 33% (1987 - from a total of 123 fish). In both 1986 and 1987 two sea trout with four previous spawning marks were recorded. Only one sea trout had spent a full winter at sea (out of 197 scaled sea trout) prior to its spawning migration. No evidence of trends in abundance of adult sea trout can be determined from this data set as it covers such a small time frame.

Analysis of historic Tavy electric-fishing surveys

Main Tavy: Salmon have been recorded on the main river as far upstream as Coffin wood (SX 540 810). The paucity of spawning gravel between Coffin wood and Tavy Cleave may inhibit further upstream migration in addition to the low flow effects of the Jewells leat abstraction. 1995 results show good densities of salmon fry and salmon parr on the main river downstream of Coffin wood within the areas quantitatively sampled. Juvenile salmon abundance has improved since pre-1983 surveys with the exception of 1992 where poor salmon fry production was evident.

Trout fry were present at virtually all main river survey sites but at quite low densities. Historical survey data usually shows low trout fry production in the main Tavy (downstream of Tavy Cleave), with most production occurring within the tributaries. Trout parr densities peak above Tavy Cleave in habitat not utilised by salmon. Consistently good trout parr abundance was found from the headwaters to Harford bridge.

Baggator brook: Four previous surveys (1970, 1989, 1992 and 1995) have not produced evidence of any salmon successfully spawning near the survey site on the Baggator brook. A large, steep natural waterfall near the bottom of the Baggator brook and being at the apparent limit of natural salmon migration are probable reasons for the above result. Trout fry densities are variable but lead to consistently high trout parr abundance.

Willsworthy brook: The Willsworthy brook is the highest Tavy tributary in which salmon regularly spawn. Salmon fry densities vary considerably and were extremely high in 1995. The spawning success on the Willsworthy brook

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may be related to the effects of abstraction for Jewells leat and Bennetts leat. However in wet autumns these effects are probably entirely masked. Very high trout fry densities in three out of the last four years are encouraging. Consistently good trout parr densities in recent years (1983 to the present) suggest a stable population fully utilising the available habitat.

Youldon brook: Salmon fry densities on the Youldon brook are either very good (1994 and 1995) or negligible (1992) suggesting spawning success is related to water flows and the numbers of adult salmon reaching this tributary. Recent surveys, as expected, show salmon parr numbers generally related to the previous years fry numbers. There is also evidence of juvenile salmon migrating into the site. Some of the highest salmon parr densities on the Tavy system have been recorded on the Youldon brook and 1995 was a good year.

Cholwell brook (Gurgie stream): The Cholwell brook flows off Dartmoor and through extensive mine workings in the Mary Tavy area. There is contamination from adits, old workings and spoil tips entering the Cholwell brook downstream of Wheal Betsy (SX 510 813) and particularly in Mary Tavy. The 1970 survey found the area at Blackdown (SX 506 797) fishless even though a trout population existed upstream of this mined area and above an insurmountable waterfall. Surveys since 1983 have shown an improvement in numbers and fish species present at Mary Tavy (SX 505 795). Since 1983 trout and a range of trout age classes have been found at the Mary Tavy site with the addition of eels in 1992. However until 1995 trout parr densities at Mary Tavy were very poor and invariably much lower than the site upstream of the old mining area or the site downstream adjacent to the Mary Tavy Power station. At the Power station trout fry production is regularly high although the abundance of older trout remains quite variable.

Juvenile salmon fry and salmon parr have only been located at the Power station site in low densities. Salmon are more susceptible to levels of metals than trout and levels of metals present such as copper, zinc, lead, silver, manganese, iron and arsenic may be reducing salmon spawning success keeping juvenile salmon abundance low. Gradual improvements in the fishery within parts of the Cholwell brook are however occurring.

Colley brook: This tributary frequently sustains high densities of salmon fry and salmon parr. However 1992 was unusually poor with no salmon fry recorded at this site. High trout fry and trout parr densities are regularly recorded.

River Burn: This tributary has produced and sustained good densities of salmon fry and parr in five out of six surveys since 1983. 1992 was a poor year for salmon fry production. Consistently high trout fry and trout parr densities have been found since surveys began in 1970 suggesting a trout population regularly reaching the natural carrying capacity of this tributary.

River Wallabrook: At the bottom of the Wallabrook a series of weirs previously supporting ram pumps provides an almost total barrier to salmon migration. A very wet autumn in 1993 enabled at least a pair of adult salmon to pass these weirs, as a number of salmon parr were found at the 1995 survey site which is upstream of these weirs. However in six other years salmon have not successfully spawned upstream of these weirs implying that they still remain virtually impassable. The extent of sea trout migration past the Wallabrook weirs is unknown although high trout fry abundance upstream suggests that some sea trout do negotiate the weirs to spawn. Trout parr densities are very good.

Mount Tavy stream (Moor Town Stream): At the bottom of the Mount Tavy Stream is a large lake within Mount House school grounds. The weirs at the bottom of this lake and below the road bridge were previously totally impassable to migratory salmonids. It is now possible for migrating salmonids to bypass the main weir by following a side leat into the lake. Previous surveys downstream of the lake have shown good densities of salmon fry and parr (except for very poor salmon fry abundance in 1992 - a poor year overall). Trout fry densities are historically fairly low although trout parr abundance is good. The survey site on Whitchurch downs, upstream of the lake revealed a good trout fry density and a fair larger trout density. Two surveys in this area late in 1989 found adult sea trout that had bypassed the Mount House lake and reached the spawning gravels beyond. However there is still no evidence of salmon successfully spawning upstream of the lake.

Tiddy brook: Two fish surveys have been carried out on the Tiddy brook (1970 and 1995). The Tiddy brook has a good trout population upstream of a large area that is heavily affected by a flood defence scheme and a large culvert underneath the Safeway superstore. Salmon parr were found in 1970 and 1991 on the Tiddy Brook. This tributary appears to be infrequently used by spawning salmon.

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River Lumburn: During the late seventies and eighties a considerable number of surveys were carried out on the Lumburn system as the river was at the time considered as a potential carrier for transporting Roadford reservoir water to Plymouth. This scheme was not carried out. Despite its size and some good spawning gravel the Lumburn between 1970 and 1985 produced negligible juvenile salmon densities. Salmon fry densities in 1989 and 1995 were better but still only moderate in comparison to other tributaries draining from similar geological areas such as the River Burn. Good trout fry densities are evident on the Lumburn generally peaking at the site farthest upstream. Trout parr densities are quite good throughout the Lumburn.

River Walkham: Except for 1992 there have been improvements in salmon fry production on the Walkham from 1983 onwards. Peak production occurs between Grenofen and Ward bridge. Salmon parr production is good on the Walkham although figures from 1983 show higher densities are possible. Merrivale occasionally provides the highest recorded upstream spawning site for salmon.

Trout fry are found throughout the Walkham in variable but generally low abundance. Peak trout spawning areas vary from year to year but Walkham tributaries seem to concentrate the spawning effort. Trout parr densities although only moderate have been quite consistent over recent years peaking around Merrivale.

Withill stream: Salmon parr were found at the Withill site in 1995, the first recorded time salmon have successfully spawned in this area. No evidence of successful salmon spawning at this site was found covering eight other years. The high water during the 1993 winter obviously aided the upstream salmon migration over some major falls downstream of the Withill site.

Good trout fry densities are regularly found on the Withill stream along with excellent trout parr densities.

Eggworthy stream: No evidence of successful salmon spawning was found here covering seven previous years. This may be accounted for by the very steep incline at the bottom of the Eggworthy brook (66m/km) and fine spawning gravel. In contrast this tributary is well used by spawning trout and has consistently high trout parr densities.

Black brook (Walkhampton stream): A large weir crosses the very bottom of the Black brook making access for migratory salmonids difficult. The weir is breaking down. Salmon penetration into the Black brook is sporadic, yielding low juvenile densities. This tributary is well used by spawning trout and has good trout parr densities.

Brook stream: Salmon have never been recorded at the survey site on the Brook stream. However this site is heavily utilised by spawning sea trout and brown trout giving excellent trout fry densities that are amongst the highest within the catchment. Trout parr densities are also very good although many juvenile trout would be expected to migrate downstream and out of the Brook stream as they outgrow it.

Milton Brook: A tidal defence gate at the confluence of the Tavy estuary and the Milton Brook does not completely restrict access to this stream for migratory salmonids. The presence of salmon parr at the survey site proves that the gate is not a total migration barrier. However it is unusual that during four fish surveys only salmon parr have been found at the survey site and not salmon fry also. The Milton Brook has a different geology in its lower reaches from all other Tavy tributaries as it is mostly a mixture of slate and bedrock. Trout fry densities are usually moderate but were high in 1983. Trout parr densities are good.

Tamerton Foliot stream: There is no evidence of salmon spawning, even sporadically, in the Tamerton Foliot stream. This stream contains a healthy trout population with good spawning especially in its upper reaches. This is fortunate as a major pollution in August 1993 killed virtually all the fish present downstream of SX 4742 6105 severely damaging the ecology of a large portion of this stream. The above pollution accounts for the very low density of trout at the Tamerton church site in 1995 which shows a very restricted age class distribution with only trout fry and 1+ trout present. A natural age class distribution (0+,1+,2+ and 3+ trout) was found at the Coombe farm site which is upstream of the area affected by the 1993 pollution.

Analysis of River Plym rod catches

Scales from very few adult Plym salmon have been aged making it impossible to comment on any trends in abundance of adult salmon. Of 12 salmon that were scaled in 1972, 83% were grilse with the remainder 2SW salmon.

During fishery surveys between 1982 and 1995 brown trout were found up to a maximum age of ten (possibly eleven) years from scales that were readable.

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Fish surveys in 1982, 1989 and 1991-1995 have recorded adult sea trout of between two and eight years of age (freshwater and sea age combined). 33% to 56% of the sea trout caught during the above surveys (from a total of 143 scaled sea trout) had spent two years in freshwater, the remainder mainly three years, with a small percentage (between 0% and 7%) of fish with four years in freshwater. The percentage of previously spawned sea trout varied between 11% (1991 - from a total of 45 fish) and 52% (1995 - from a total of 24 fish). In 1989 a sea trout with five previous spawning marks was recorded. No evidence of trends in abundance for adult sea trout can be determined from the data set of scaled sea trout currently available.

Analysis of historic Plym electric-fishing surveys

Upper Plym subcatchment: Surveys of the Plym catchment show that above the Dewerstone gorge on the main Plym only trout are found whereas downstream of the gorge salmon are also present. Despite various attempts to improve access for salmon through the Dewerstone gorge there is currently no evidence of salmon successfully spawning upstream of this area. However sea trout regularly spawn upstream of the Dewerstone gorge, even in drought years.

1995 juvenile trout fry densities are good upstream of the Dewerstone gorge and many offspring produced in this area are as a result of sea trout spawning. Trout fry densities decrease at the highest Plym site where there is a greater abundance of older trout age classes. The weir at the Ditsworthy leat may severely impede the upstream migration of adult sea trout reducing upstream trout fry production to that of resident brown trout. In addition smolts produced upstream of the Ditsworthy weir are likely to migrate down the leat. No released hatchery salmon juveniles or wild salmon offspring have been found during a number of fish surveys carried out upstream of Cadover bridge.

Lower Plym subcatchment: Trout fry densities are low on the main Plym downstream of Dewerstone gorge suggesting minimal spawning in this area by sea trout or resident brown trout. Older trout populations in this area are therefore mainly as a result of natural downstream migration of trout from spawning areas upstream. Older trout densities generally decline downstream from the main trout spawning areas.

Salmon fry densities are very variable on the lower Plym but are low in comparison to results from the Meavy. Late winter salmon can spawn in the lower Plym especially if water conditions impede access to the Meavy. Most salmon spawning occurs on the Meavy. Salmon parr densities are generally good at Ham but become poorer from Great Shaugh wood downstream.

Meavy: Annual fish surveys have been carried out on the Meavy since 1991 to help assess the impact of the regulated flow from Burrator on the migratory salmonid population (also see A.L.F section 5.2).

An exceptionally poor year for salmon fry production was recorded in 1992 with only 40% of the sites historically recording salmon fry actually doing so. Where salmon fry were found densities were much lower than expected. In contrast salmon fry production in 1993, 1994 and 1995 has been very high throughout the Meavy with salmon fry densities peaking at Gratton bridge. The distribution of spawning salmon in two out of the last five years reached the highest available spawning gravel at the confluence with the Sheepstor brook (SX 5512 6752).

The poor salmon fry production noted in 1992 was reflected in a poor year for salmon parr in 1993 and is likely to result in a poor grilse run in 1995. Densities of salmon parr were however good in 1991, 1992, 1994 and 1995. The majority of salmon parr production occurs on the Meavy.

Trout fry production is high on the Meavy varying between an extremely good year in 1982 to relatively low production in 1993. Peak trout fry densities occur on the Lovaton brook.

Trout parr densities within the Meavy consistently sustain good levels.

Fish survey sites inaccessible to salmon and sea trout (Sheepstor brook and sites above Burrator reservoir) show high variability in trout fry densities but often have high trout parr densities. The highest historic trout parr density was recorded on the Narrator brook in 1989 at 85.7 trout parr/100m².

Glenholt stream: A low density of juvenile salmon was recorded in 1971 on this stream. A reasonable trout density was recorded.

Happy Valley stream: Low juvenile densities of salmon and trout were found in 1971.

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Tory brook: Few fish surveys have been carried out on the Tory brook (1992 and 1995) as this river has been considered a hostile environment for fish species. The 1992 fish survey found extremely poor salmonid densities on the main Tory brook with none present at Newnham Park (SX 5519 5771) and above. The presence in 1992 of low densities of salmon fry and salmon parr within the area surveyed through Plympton was unexpected. A major decline in fish species diversity was evident from the 1995 survey with no trout or salmon juveniles found on the Tory brook and also an absence of bullhead and three-spined stickleback at the Plympton sites. Eels were the only fish species capable of survival within all of the Tory brook in 1992 and were found only as far upstream as Newnham Park in 1995. Eels were only present in low numbers.

In direct contrast, fish surveys on two tributaries of the Tory brook that are not currently affected by clay discharges have shown good trout populations although no juvenile salmon. Sea trout spawn in the Smallhanger brook and probably also use the Elfordleigh brook. During their spawning migration these sea trout must pass through the lower part of the Tory brook which is currently proving uninhabitable to salmonids in the longer term. Historically the headwaters of the Smallhanger Brook were mined for china clay extraction, although these areas have become more stabilised by the growth of land and aquatic vegetation.

Analysis of River Yealm rod catches

Scales from very few Yealm salmon have been aged making it impossible to comment on any trends in abundance of adult salmon. Salmon that have been scaled were either grilse or 2SW salmon and the majority had spent two (some three) years in freshwater.

In the 1987, 1992 and 1995 surveys brown trout were found up to a maximum age of five years from scales that were readable.

In 1995 adult sea trout were found of between two and five years of age (freshwater and sea age combined). 60% to 71% of the sea trout caught during the 1987, 1992 and 1995 fish surveys (Total of 72 scaled sea trout) had spent two years in freshwater, the remainder three years. The percentage of previous spawned sea trout varied between 37% (1987 - from a total of 62 fish) and 50% (1995 - from a total of 20 fish). Too few sea trout were captured in 1992 (5 fish) to provide a good comparison of previous spawners to maiden fish. In both 1987 and 1992 a sea trout with four previous spawning marks was recorded. No evidence of trends in abundance of adult sea trout can be determined from the limited data set of scaled sea trout currently available.

Analysis of historic Yealm electric-fishing surveys

Upper Yealm (U/S Blachford lake): There are no records of juvenile salmon above Blachford lake. This may be due to the weirs at Blachford proving impassable to adult salmon or that the natural salmon distribution would not extend beyond Blachford even if Blachford lake did not exist. Bullhead and eels are the only fish species other than trout found above Blachford lake.

Trout fry densities are considerably higher above Blachford lake, than further downstream, suggesting most brown and sea trout spawning occurs upstream of Blachford lake. This contrast was particularly exaggerated in the 1995 fish survey results with negligible trout fry densities from Woodburn farm (SX 6020 5714) downstream to the estuary. The trout parr distribution is also strongly biased to the headwaters as shown in all three complete fish surveys (1987, 1992 and 1995) with low trout parr densities downstream of the lake and over the remainder of the main river. This is particularly obvious with the 1995 1+ trout age class which is virtually absent over the lower half of the Yealm. The area just upstream of Blachford lake contains the highest trout parr density so far recorded on the Yealm catchment. The 1987 fish survey recorded adult sea trout at two sites above Blachford lake during August and September.

The two tributaries surveyed above Blachford lake have excellent trout populations with considerable trout spawning evident. A complete fish kill occurred throughout the Redaven lake stream around the 5/05/89 and downstream of SX 627 615. This tributary has recovered extremely well considering two difficult 4ft natural falls exist at the confluence of this stream with the Yealm.

Middle/Lower Yealm (D/S Blachford): Salmon fry densities were good in the middle reaches of the Yealm in 1995 but from historic data it is apparent that spawning areas vary annually. This may be associated with flow conditions determining the extent of upstream migration or a limited spawning stock unable to fully utilise the available spawning gravel. Salmon parr densities were lower than expected in 1995.

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Trout parr densities are much lower downstream of Blachford lake and decrease in a downstream direction. Historically these trout parr densities are quite similar between Yealm surveys but are lower than expected in comparison to other river systems.

River Piall: In most surveys salmon fry have been recorded on the Piall (except 1987). The distribution of spawning salmon reaches Slade (SX 601 586) although the production at this site is small. Salmon parr production on the Piall overall is limited. Salmon have not been recorded at the Lutton site or on the Delamore stream.

Trout fry densities were poor in 1995 in comparison to good production in 1987 and 1992. A pollution on 27/05/92 caused a major fish kill affecting the upper reaches of the Piall. This adversely affected trout parr densities in 1992 with none recorded at Lutton on 1/07/92. Trout fry abundance appeared to be unaffected by this pollution with high densities recorded. Apart from the impact of this incident at Lutton there is historically little variation in trout parr densities on the main Piall.

Delamore stream: Trout densities of both fry and parr have decreased substantially on the Delamore stream from the very high levels recorded in 1987. The drained lower lake and piped stream flow downstream of the survey site on the Delamore stream may almost completely impede trout spawning migrations. A lake upstream of the survey site may also be affecting the survey site.

Ridgecot lake: A marked decrease in the trout population is evident on the Ridgecot lake stream between 1987 and 1992. The 1992 fisheries data was collected after two pollution incidents in 1990 which may help explain the low survey densities recorded in 1992. Fish kills however were not reported with these incidents. A recovery in the trout population to 1987 population levels would have been expected by 1995. The extremely low trout population found in 1995 suggests a more persistent problem on this tributary.

Lee Mill stream: The 1987 survey site was found to be completely fishless. The 1995 survey recorded very low densities of trout, salmon and eel. It is evident that some improvement has occurred in the ability of this stream to support fish, albeit in low numbers. The removal of tree debris in the lower parts of this stream may aid recolonisation by salmonids and improve the flow regime.

Brook lake: A single salmon parr was recorded in the Brook lake in 1995. Previously no juvenile salmon have been recorded in this tributary. Although a good trout population was apparent from 1987 and 1992 results, the 1995 fish survey showed a low population of trout fry and poor trout parr abundance.

Long Brook: Salmon parr are regularly recorded on the Long Brook although the complete lack of salmon fry recorded from three fish surveys suggests spawning occurs elsewhere. Good trout populations were recorded on the Long Brook in 1987 and 1992. The 1995 survey showed poor densities of trout fry, trout parr and salmon parr.

Silverbridge Lake: Salmon juveniles have never been recorded on this stream which enters the Yealm estuary via Kitley Lake. Good trout densities have been found on this tributary with greater trout fry production further upstream. Sea trout spawn within the Silverbridge lake stream despite tide dependant access from the estuary into Kitley Lake. The existence of a self perpetuating population of dace within this stream is unusual. The Tamar is the only other river system in the Cornwall area known to contain a dace population and the Tamar population was considered to have originated from artificial stocking, or escapees from Tamar Lakes.

Fordbrook: Routine fish sampling of the Fordbrook in 1992 and 1995 revealed a low abundance of trout parr with no evidence of trout fry production. No juvenile salmon were recorded.

Newton Ferrers stream: No juvenile salmon have been recorded within this stream. Trout fry production is good at the higher survey site but the densities of trout parr found within the downstream survey site are surprisingly poor.

Summary of River Lynher- River Tiddy routine electric fishing survey 1993 and selected 1990 sites

RIVER	SITE	NGR	DATE	SURVEY	CLUSTER	POPULATION DENSITIES GIVEN IN NO. FISH / 100m2				OTHER SPECIES
						TROUT 0+	TROUT >=1+	SALMON 0+	SALMON >=1+	
LYNHER	Trewint Marsh	SX 2175 7955	09/08/93	1 RUN	BG	46.3	9	0	0	E
	Trewint Works	SX 2166 8008	06/08/93	1 RUN	BG	21	18.5	0	0	B
	Tregirls	SX 2218 7984	06/08/93	3 RUN	BG	94.1	31.2	0	0	E,B
	Trenilk	SX 2266 7974	10/08/93	1 RUN	BG	15.5	29.3	0	0	E,B,M
	Tregrenna	SX 2328 7962	09/08/93	1 RUN	BH	19.4	21.6	10.3	3.9	E,B
	Trevague	SX 2395 7947	11/08/93	1 RUN	BH	8.7	21.3	8.1	1.1	B
	Knighton	SX 2517 7940	10/08/93	3 RUN	BH	12.3	20.4	12.7	2.7	E,B,L,M
	Trebartha	SX 2639 7795	11/08/93	1 RUN	BH	10.9	22.2	27.3	5.2	E,B,L,ST
	Berriowbridge	SX 2728 7578	13/08/93	1 RUN	BI	7.7	9.8	39.5	8.3	E,B,ST
	Bathpool	SX 2836 7462	17/08/93	3 RUN	BI	5	5.6	28.8	6.6	E,B,L,SS
	Stara Bridge	SX 289 738	20/08/93	1 RUN	BI	2.4	7.9	4.9	5.5	E,B,ST
	Rilla Mill	SX 292 735	23/08/93	1 RUN	BI	9	5.4	8.4	4.3	E,B,L,ST
	Plushabridge	SX 303 725	23/08/93	1 RUN	BI	5.5	4.8	24.6	4.9	E,B,L,ST ,SS
	Kearney Bridge	SX 319 709	25/08/93	3 RUN	BJ	1.8	10.7	6.9	3.2	E,B,L,ST
	Bicton Bridge	SX 322 700	25/08/93	1 RUN	BJ	4.4	7.9	24.9	5.4	E,B,L,ST ,SS
	Newbridge	SX 347 679	23/08/93	1 RUN	BK	4.5	8.9	23.1	4.6	E,B,L,ST
	Clapper Bridge	SX 353 654	24/08/93	3 RUN	BK	3	7.6	11.4	1.8	E,B,L,ST ,SS
	Pillatonmill	SX 365 633	24/08/93	1 RUN	BK	1.3	3.3	15.1	4.1	E,B,L,ST ,SS
Hendra Brook	Hendra	SX 2093 7966	05/08/93	1 RUN	BG	89.1	20.3	0	0	B
WITHEY BROOK	Newel Tor	SX 242 743	14/09/90	3 RUN		3.1	46.9	0	0	E
	Bastrect	SX 246 764	13/09/90	3 RUN		16.6	20.2	0	0	E

RIVER	SITE	NGR	DATE	SURVEY	CLUSTER	POPULATION DENSITIES GIVEN IN NO. FISH / 100m2				OTHER SPECIES
						TROUT 0+	TROUT >=1+	SALMON 0+	SALMON >=1+	
Deans Brook	Deans Brook	SX 382 624	17/09/90	3 RUN	-	13.2	19.3	13.2	2.6	E,B,L
TIDDY BROOK	Cutkive Wood	SX 2919 6768	20/07/93	3 RUN	AW	65.5	0.5	0	0	E,B,L
	Treweatha	SX 2940 6560	20/07/93	1 RUN	AW	26.3	34.5	3.1	0	E,B
	Hepwell Bridge	SX 3048 6428	20/07/93	1 RUN	AW	7.3	38.1	1.8	1.7	E,B,SS
	Tilland	SX 3310 6168	20/07/93	1 RUN	AX	6.3	8.7	2.2	2.2	E,B,L
	Cutnere	SX 3295 6062	20/07/93	1 RUN	AX	2.3	15	0.7	0.9	E,B,L,ST
	Heskyn Mill	SX 3435 5955	20/07/93	3 RUN	AX	1.3	16.2	0	0.5	E,B,L,ST
Hay Lake	Tilland	SX 332 620	12/09/90	3 RUN	-	6.6	23.6	0.9	0.9	E,B,L

Key
 E-Eel B-Bullhead L-Brook lamprey M-minnow ST-Adult sea trout SS-Adult salmon

River Tavy routine electric fishing survey 1995 (including summer ALF sites)

SITE NO.	RIVER	SITE	NGR	DATE	SURVEY	CLUSTER	POPULATION DENSITIES GIVEN IN NO. FISH / 100m2				OTHER SPECIES
							TROUT 0+	TROUT >=1+	SALMON 0+	SALMON >=1+	
1	TAVY	Rattlebrook	SX 5617 8410	13/06/95	1 RUN	AH	3.4	51.4	0	0	
2		Tavy Cleave	SX 5617 8410		NOT SURVEYED						
3		Nattor	SX 548 823	08/06/95	3 RUN	-	2.9	15.9	0	0	E
4		Hill Bridge	SX 5355 8057	09/06/95	3 RUN	-	2.0	13.0	11.5	34.2	E
5		Creason Wood	SX 5305 8010	14/06/95	3 RUN	-	2.6	19.3	10.1	21.8	E
6		Horndon	SX 5235 7958	16/06/95	3 RUN	-	2.4	16.1	13.2	46.6	E
7		Iron Bridge	SX 5117 7863	20/06/95	3 RUN	AF	3.7	25.4	58.2	37.7	E
8		U/S Harford Br.	SX 5050 7688	21/06/95	1 RUN	AF	6.4	11.9	43.1	52.3	E,B
9		Evans Weir	SX 4925 7515	28/06/95	3 RUN	AG	1.1	7.5	63.3	33.9	E,B
10		Brook Mill	SX 4774 7316	28/06/95	3 RUN	AG	1.3	7.8	28.5	23.5	E,B,SL
11		Langham Wood	SX 4664 7121	23/06/95	DIP	-	P	A	P	P	E,B,SL,L,M

SITE NO.	RIVER	SITE	NGR	DATE	SURVEY	CLUSTER	POPULATION DENSITIES GIVEN IN NO. FISH / 100m2				OTHER SPECIES
							TROUT 0+	TROUT >=1+	SALMON 0+	SALMON >=1+	
12		Sausage Factory	SX 4682 7056	23/06/95	DIP	-	P	P	P	P	B,SL,ST
13		U/S Double Waters	SX 4765 7007	26/05/95	DIP	-	A	A	P	P	E,B,SL,L,M
14		Balstone	SX 4694 6873	23/06/95	DIP	-	P	A	P	P	E,B
15		U/S Denham Br.	SX 4770 6805	26/06/95	DIP	-	P	A	P	P	E,B,SL,M
16		Denham Woods	SX 4705 6748	26/06/95	DIP	-	P	A	P	P	E,B,SL,L,M
17	Baggator Brook	Baggator	SX 5456 8098	08/06/95	1 RUN	AH	12.4	36.7	0	0	
18	Wilsworthy Brook	Wilsworthy	SX 5330 8168	05/06/95	3 RUN	AO	60.5	30.1	126.8	16.7	E
19	Youldon Brook	Youlden	SX 5331 8023	06/06/95	3 RUN	AH	26.4	44.2	69.8	53.9	E
20	Cholwell Brook	Cholwell	SX 5112 8137	21/06/95	1 RUN	AJ	19.8	41.8	0	0	
21		Mary Tavy	SX 5055 7948	06/06/95	1 RUN	AJ	8.3	16.1	0	0	E
22		Power Station	SX 5084 7845	12/06/95	3 RUN	AJ	8.9	19.9	0	2.8	E
23	Colly Brook	Colly Brook	SX 5115 7760	22/06/95	3 RUN	AI	63.2	38.3	205.5	64.0	E
24	RIVER BURN	Burn Ford	SX 4969 7890	19/06/95	3 RUN	-	25.7	36.4	83.3	10.4	E,B,L
25		Burn Bridge	SX 5018 7654	13/06/95	1 RUN	AI	30.6	25.7	151.6	32.6	E,B,L
26	Wallbrook	Wallbrook	SX 4862 7571	12/06/95	1 RUN	AI	64.3	32.1	0	2.8	E,B
27	Mount Tavy stream	Whitchurch Down	SX 5079 7417	05/07/95	1 RUN	AI	47.1	26.5	0	0	E,B,L
28		Mount Tavy	SX 4907 7480	21/06/95	1 RUN	AI	6.1	40.7	44.2	9.8	E,B,L
29	Tiddy Brook	Anderton	SX 4836 7273	06/07/95	1 RUN	AI	14.0	25.7	0	0	E,B,L
30	RIVER LUMBURN	Lamerton	SX 4492 7626	12/07/95	1 RUN	AI	23.8	58.4	22.3	3.6	E,B,L
31		U/S Mill Hill	SX 4532 7456	11/07/95	1 RUN	AN	1.3	17.9	0.7	6.5	E,B,L
32		D/S Mill Hill	SX 4567 7422	11/07/95	1 RUN	AN	11.1	18.8	20.2	1.4	E,B,L
33		U/S Lumburn	SX 4594 7321	11/07/95	1 RUN	AN	7.7	13.3	12.0	1.3	E,B,SL,L,M
34		D/S Lumburn	SX 4500 7302	11/07/95	1 RUN	AN	3.7	11.0	20.4	4.8	E,B,SL,L,M
35		Shilla Mill	SX 4661 7200	10/07/95	3 RUN	AN	5.2	10.4	4.8	11.5	E,B,L,M

SITE NO.	RIVER	SITE	NGR	DATE	SURVEY	CLUSTER	POPULATION DENSITIES GIVEN IN NO. FISH / 100m2				OTHER SPECIES
							TROUT 0+	TROUT >=1+	SALMON 0+	SALMON >=1+	
36	RIVER WALKHAM	Greenaball	SX 5713 7804		NOT SURVEYED						
37		Merrivale	SX 5514 7545	04/07/95	1 RUN	AO	29.2	26.6	11.1	0	E
38		Heckwood	SX 5444 7320	12/07/95	1 RUN	AK	12.0	12.1	28.9	9.7	E
39		Ward Bridge	SX 5428 7210	03/07/95	3 RUN	AK	25.3	12.2	167.2	17.3	E
40		Huckworthy	SX 5330 7070	04/07/95	1 RUN	AK	5.8	11.4	33.9	17.1	E,B
41	RIVER WALKHAM	Foxhams	SX 5192 6973	27/06/95	3 RUN	AL	7.1	11.4	77.3	25.9	E,B, ST
42		D/S Bedford Br.	SX 5028 7033	30/06/95	1 RUN	AL	0.6	11.8	48.2	10.3	E,B
43		Grenofen	SX 4916 7075	30/06/95	1 RUN	AL	4.0	7.9	70.7	10.9	E,B
44		Bucktor	SX 4808 7010	29/06/95	1 RUN	AL	2.4	3.8	14.7	14.8	E,B,ST
45	Withill stream	Withill	SX 5494 7277	07/07/95	1 RUN	AM	37.0	34.7	0	12.4	E
46	Eggworthy stream	Eggworthy	SX 5452 7168	10/07/95	1 RUN	AM	7.7	37.6	0	0	E
47	Black Brook	Walkhampton	SX 5286 7018	05/07/95	3 RUN	AM	57.0	19.0	0	0.6	E,B
48	Brook stream	Brook Stream	SX 5250 7145	05/07/95	1 RUN	AM	58.6	21.0	0	0	E,B
49	Milton Coombe stream	Milton Coombe	SX 4815 6475	06/07/95	3 RUN	AM	6.0	14.6	0	13.0	E,B
50	Tamerton Foliot stream	Coombe Farm	SX 4836 6140	03/08/95	3 RUN	-	84.1	16.7	0	0	E
51		Tamerton Church	SX 4712 6090	03/08/95	3 RUN	-	2.6	3.5	0	0	E,B

Autumn ALF Survey - River Tavy

SITE NO.	RIVER	SITE	NGR	DATE	SURVEY	CLUSTER	POPULATION DENSITIES GIVEN IN NO. FISH / 100m2				OTHER SPECIES
							TROUT 0+	TROUT >=1+	SALMON 0+	SALMON >=1+	
2	TAVY	Tavy Cleave	SX 5617 8410	NOT SURVEYED							
3		Nattor	SX 548 823	08/09/95	3 RUN	-	6	11.8	0	0	E
4		Hill Bridge	SX 5355 8057	01/09/95	3 RUN	-	2.5	17.1	34.4	23.5	E
5		Creason Wood	SX 5305 8010	13/09/95	3 RUN	-	4.3	27.4	34.9	28.3	E
7		Iron Bridge	SX 5117 7863	04/09/95	3 RUN	AA	3.6	31.4	53.3	48.1	E

8		U/S Harford Br.	SX 5050 7688	05/09/95	1 RUN	AA	6	20.3	88.9	51.9	E,B
9		Evans Weir	SX 4925 7515	20/09/95	1 RUN	BB	3.1	3	50.7	16.2	E,B,ST
10		Brook Mill	SX 4774 7316	08/09/95	3 RUN	BB	2.1	6.9	26.2	26.4	E,B,SL,M,ST
18	Wilsworthy Brook	Wilsworthy Brook	SX 5330 8168	11/09/95	3 RUN	-	41.6	27.4	140	10.5	
19	Youldon Brook	Youldon Brook	SX 5331 8023	14/09/95	3 RUN	-	35	36.3	161.6	45.8	E
22	Cholwell Brook	Power Station	SX 5084 7845	06/09/95	3 RUN	-	13.8	20.5	2.2	2.2	E
23	Colly Brook	Colly Brook	SX 5115 7760	05/09/95	3 RUN	-	59.6	24	183.6	49.3	E
24	RIVER BURN	Burn Ford	SX 4969 7890	12/09/95	3 RUN	-	20.2	28.4	79	9.4	E,B,L

Key

E-eel B-bullhead SL-Stone loach L-Brook lamprey M-Mimow ST-Adult sea trout

Notes: Dip survey results, P - Present, A - Absent

Summary results of Alleviation of Low Flows (ALF) study and routine electric fishing survey River Plym 1995

	RIVER	SITE		NGR	DATE	SURVEY	CLUSTER	POPULATION DENSITIES GIVEN IN NO. FISH / 100m2.				OTHER SPECIES
								TROUT 0+	TROUT >=1+	SALMON 0+	SALMON >=1+	
1	PLYM	Harvor	*	SX5995 6720	14/06/95	3 RUN	AA	12.2	45.8	0	0	
2		Ditsworthy Warren	*	SX5836 6606	13/06/95	1 RUN	AA	53.9	34.3	0	0	E
3		Brisworthy	*	SX5666 6512	13/06/95	1 RUN	AA	9.3	20.8	0	0	E
4a		U/S Cadover	*	SX5628 6444	20/06/95	1 RUN	AB	50.9	21.1	0	0	E
4b		Cadover Bridge	*	SX5565 6465	15/06/95	3 RUN	AB	49.8	23.4	0	0	E
5		Lower Cadworthy	*	SX5509 6426	20/06/95	3 RUN	AB	6.2	17.5	0	0	E,ST
6		Ham		SX5304 6225	03/07/95	3 RUN	AC	5.3	20.2	18	26.4	E,B,ST
7		Great Shaugh Wood		SX5198 6078	30/06/95	1 RUN	AC	1.4	3.4	28.8	2.8	E,B
8		Plym Bridge		SX5221 5864	27/06/95	DIP	-	P	P	P	P	E,B,F
9	Blacka Brook	Blacka	*	SX5648 6440	08/06/95	3 RUN	-	25.9	32.9	0	0	E
10	MEAVY	Black Tor	**	SX5681 6981	09/06/95	1 RUN	AE	0	25.6	0	0	

	RIVER	SITE		NGR	DATE	SURVEY	CLUSTER	POPULATION DENSITIES GIVEN IN NO. FISH / 100m2.				OTHER SPECIES
								TROUT 0+	TROUT >=1+	SALMON 0+	SALMON >=1+	
11		Burrator		SX5512 6752	05/06/95	1 RUN	AD	46.4	44.6	32.1	0.9	E
12		Yeo Farm		SX5499 6715	05/06/95	1 RUN	AD	41.4	19.3	38.1	17.1	E,SB
13		Marchams Cross		SX5450 6695	06/06/95	3 RUN	AD	37.7	22	96.2	23.8	E
14		Gratton		SX5289 6699	27/06/95	1 RUN	AG	118.5	3.4	413.1	48.9	E
15		Olderwood		SX5253 6676	27/06/95	1 RUN	AG	19.2	13.7	134.7	25.1	E
16		Chub Tor		SX5231 6628	23/06/95	3 RUN	AG	68.1	39.3	104.5	26.5	E,SB,ST
17		Hoo Meavy		SX5262 6581	21/06/95	3 RUN	AH	25.2	21.1	172.4	16.2	ST
18		Clear Brook		SX5263 6527	22/06/95	1 RUN	AH	23.5	12.8	29.3	41.9	E
19	MEAVY	Goodameavy		SX5299 6455	22/06/95	1 RUN	AF	20.7	21.6	243.3	41.7	E
20		Dewerstone		SX5349 6427	23/06/95	3 RUN	AF	24.9	25.4	106.3	17.4	E,ST
21	Newleycombe Lake	Newleycombe Lake	**	SX5702 6944	09/06/95	3 RUN	AE	14.8	44	0	0	RT
22	Narrator Brook	Narrator	**	SX5700 6898	12/06/95	1 RUN	AE	53.8	25.4	0	0	
23	Sheepstor Brook	Sheepstor		SX5538 6763	08/06/95	3 RUN	-	4.1	51.8	0	0	
24	Lovaton Brook	Lovaton		SX5370 6695	16/06/95	3 RUN	-	194.8	31.1	0	0.8	E
25	TORY BROOK	Portworthy		SX5560 6000	30/06/95	1 RUN	-	0	0	0	0	
26		Newnham Park		SX5519 5771	29/06/95	1 RUN	-	0	0	0	0	E
27		Plympton Playing Fields		SX5361 5639	29/06/95	1 RUN	-	0	0	0	0	E
28		Plympton		SX5250 5665	29/06/95	1 RUN	-	0	0	0	0	E,F
29	Smallhanger Brook	Furzeacre Bridge		SX5595 5775	30/06/95	1 RUN	AI	36.7	13.1	0	0	E
30	Elfordleigh Brook	Binicliffe		SX5512 5776	29/06/95	3 RUN	AI	69.7	10.5	0	0	E,B

Key

Eel B-bullhead ST-Adult sea trout SB-Three spined stickleback F-flounder RT-Rainbow trout

Note: Dip survey results ,P -Present, A -Absent, * -Survey site u/s of Dewerstone Falls, ** -Survey site u/s of Burrator Reservoir

Results of Autumn ALF survey for River Meavy sites 1995

	RIVER	SITE	NGR	DATE	SURVEY	CLUSTER	POPULATION DENSITIES GIVEN IN NO. FISH / 100m2.				OTHER SPECIES
							TROUT 0+	TROUT >=1+	SALMON 0+	SALMON >=1+	
11	MEAVY	Burrator	SX5512 6752	15/09/95	1 RUN	AD	19.6	43.1	23.7	1.3	E
12		Yeo Farm	SX5499 6715	15/09/95	1 RUN	AD	14.1	15.5	24.6	14.8	E
13		Marchams Cross	SX5450 6695	18/09/95	3 RUN	AD	21.2	19	46.7	10.5	E
14		Grauton	SX5289 6699	15/09/95	1 RUN	AG	41.7	11.3	238.4	37.5	E
15		Olderwood	SX5253 6676	18/09/95	1 RUN	AG	17.5	29.9	60.1	38.4	E
16		Chub Tor	SX5231 6628	22/09/95	3 RUN	AG	38.4	25.2	49.3	9.1	E,SB
17		Hoo Meavy	SX5262 6581	19/09/95	3 RUN	AH	10	24.5	59.7	3.1	E,ST
18 a		U/S Clearbrook S.T.W.	SX5263 6522	19/09/95	3 RUN	AH	27.9	28.3	120.2	18.5	E,ST
18 b		D/S Clearbrook S.T.W.	SX5268 6503	20/09/95	3 RUN	AH	26.6	17.4	29	14.0	E,ST
19		Goodameavy	SX5299 6455	21/09/95	1 RUN	AF	12	10.7	62.5	38	E
20		Dewerstone	SX5349 6427	21/09/95	3 RUN	AF	16.1	25.1	87.1	19	E,ST

River Yealm routine electric fishing survey 1995, summary results

	RIVER	SITE		NGR	DATE	SURVEY	CLUSTER	POPULATION DENSITIES GIVEN IN NO. FISH PER 100m2.				OTHER SPECIES
								TROUT 0+	TROUT >=1+	SALMON 0+	SALMON >=1+	
1	YEALM	Dendles Wood	*	SX6160 6180	25/07/95	3 RUN	AA	59.3	29	0	0	E
2		South Hele	*	SX6137 6070	26/07/95	1 RUN	BB	81.5	36.1	0	0	E,B
3		Blachford U/S	*	SX6125 6003	20/07/95	3 RUN	BB	18.7	53.3	0	0	E,B
4		Blachford D/S		SX6090 5960	21/07/95	3 RUN	CC	16.9	11.9	3.9	5.1	E,B
5		Putta Pool		SX6080 5900	21/07/95	1 RUN	CC	15.9	8.1	65.4	4.5	E,B,M
6		Woodburn Farm		SX6020 5714	19/07/95	1 RUN	DD	3	4.5	62.2	8.4	E,B,M,L,ST
7		Polsons Wood		SX6027 5663	19/07/95	3 RUN	DD	0.4	7.6	55.2	6	E,B,M
8		Southwood Wood		SX5979 5464	17/07/95	1 RUN	EE	1.8	7.9	12.7	12.8	E,B,M
9		Treby Ham		SX5954 5365	18/07/95	3 RUN	EE	0.5	4.2	32.3	3.7	E,B,M,L,ST,SS

	RIVER	SITE		NGR	DATE	SURVEY	CLUSTER	POPULATION DENSITIES GIVEN IN NO. FISH PER 100m2.				OTHER SPECIES
								TROUT 0+	TROUT >=1+	SALMON 0+	SALMON >=1+	
10		Worston Ford		SX5943 5262	14/07/95	1 RUN	FF	0	3.2	12.8	2.6	E,B,M,L
11		Yealmpton Mill		SX5848 5170	17/07/95	1 RUN	FF	0	5.4	7.2	3.2	E,B,L
12		Puslinch Bridge		SX5680 5107	13/07/95	3 RUN	FF	0.2	1.2	3.3	1.9	E,B,M,L,SG,F,ST
13	Broadall Lake	Dendles Green	*	SX6153 6178	25/07/95	1 RUN	AA	107.2	30.7	0	0	E
14	Redaven Lake	Wisdoms Mill	*	SX6133 6092	26/07/95	1 RUN	RR	95.6	23	0	0	E
15	RIVER PLALL	Lutton		SX5966 5965	01/08/95	1 RUN	RR	22	7.2	0	0	B,L
16		Slades Bridge		SX6000 5865	27/07/95	1 RUN	RR	7.5	12.6	3.3	1	E,B,L,ST,
17		Marks Bridge U/S		SX5994 5757	27/07/95	3 RUN	RR	3.1	9.3	6.6	2.8	E,B,L,ST
18	Delamore stream	Delamore Farm		SX6007 5953	01/08/95	1 RUN	SS	1.3	1.3	0	0	E,B
19	Ridgecot Lake	Three Streams		SX6008 5703	01/08/95	1 RUN	RR	1.2	1.7	0	0	E,B,L
20	Lee Mill stream	Lee Mill		SX5982 5463	17/07/95	1 RUN	RR	1.3	2.9	0	0.9	E
21	Brook Lake	Brook Lake		SX5985 5426	01/08/95	1 RUN	RR	9.4	2	0	1	E,B
22	Long Brook	Long Brook		SX5950 5217	24/07/95	3 RUN	QQ	0	2.5	0	1.2	E,B
23	SILVERBRIDGE LAKE	Efford	**	SX5696 5333	31/07/95	1 RUN	TT	42.3	9.8	0	0	E,B,D,ST
24		Pondfield	**	SX5625 5206	14/07/95	3 RUN	TT	14.4	14.4	0	0	E,B,D,F
25	Fordbrook	Cofflete		SX5410 5177	18/07/95	1 RUN	QQ	0	1.3	0	0	E,F
27		Gnaton		SX5790 4842	24/07/95	1 RUN	TT	12.9	0	0	0	E,B
26	NEWTON FERRERS	Bridgend		SX5572 4822	24/07/95	1 RUN	TT	0	2	0	0	E,B

Key

E-Eel B-bullhead L-Brook lamprey M-minnow ST-Adult sea trout SS-Adult salmon F-flounder D-dace SG-Sand goby

Notes: * -Survey site u/s Blachford Lake, ** Survey site u/s of Kitley Pond

Summary of routine electric fishing survey - Tamar catchment below Gunnislake weir 1993

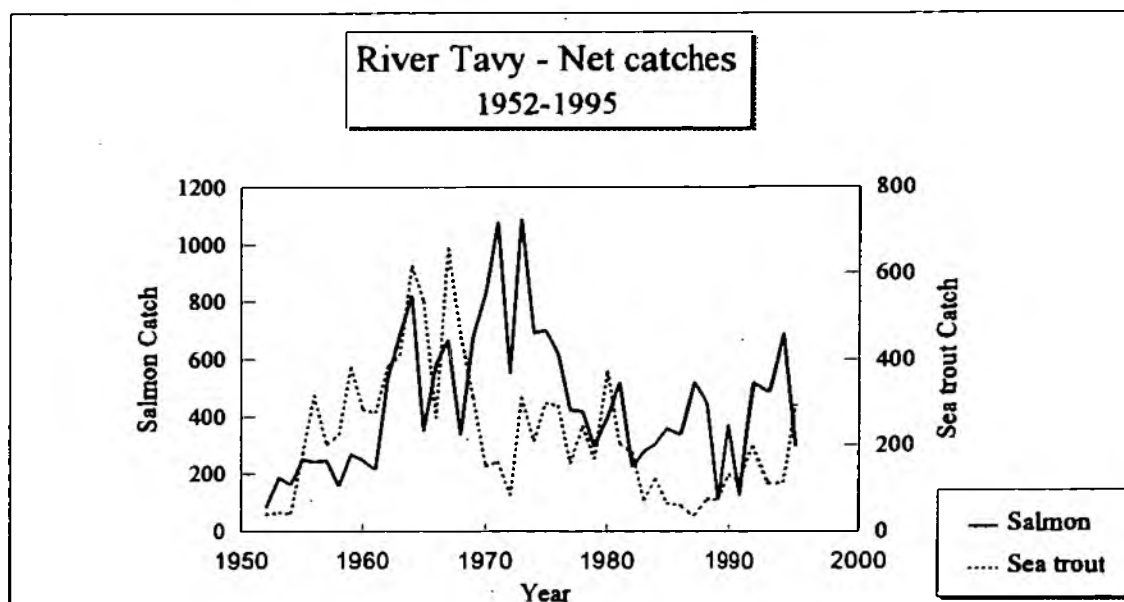
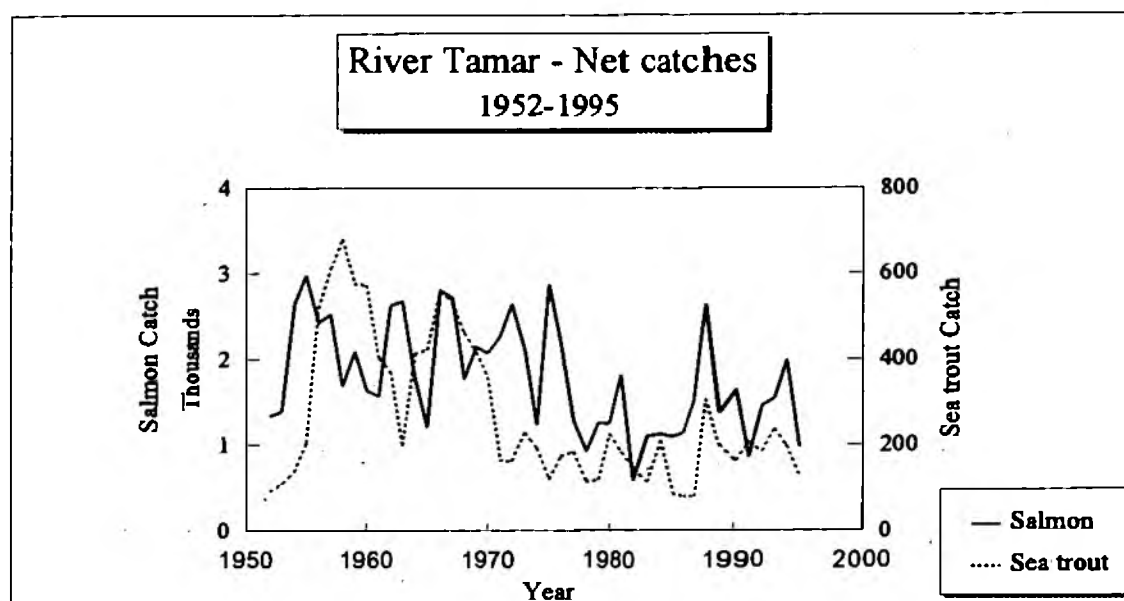
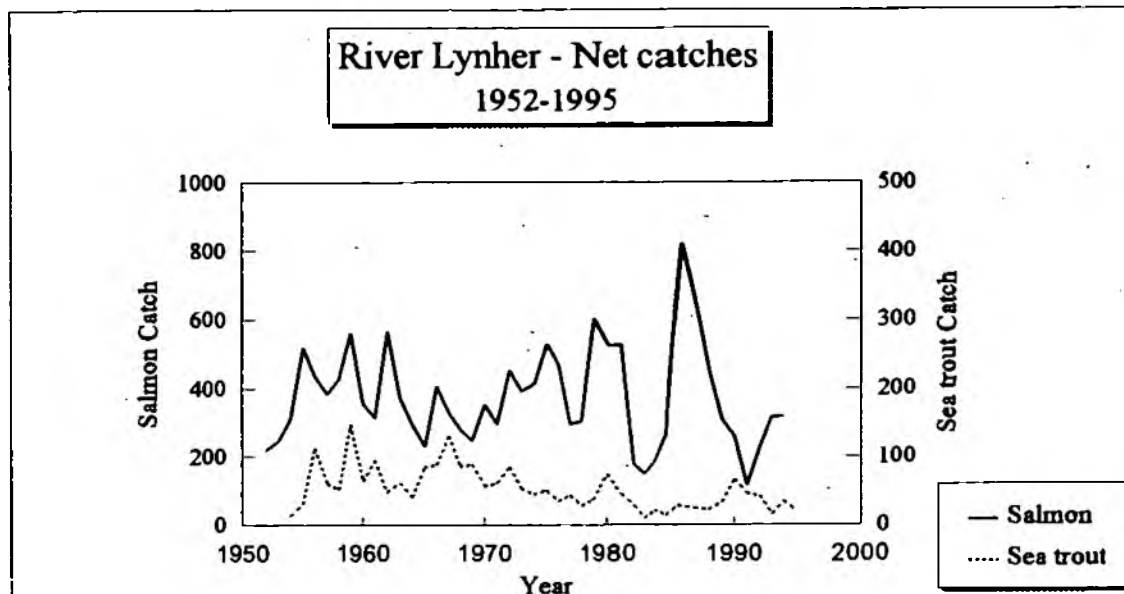
							POPULATION DENSITIES GIVEN IN NO. FISH / 100m2				OTHER
	RIVER	SITE	NGR	DATE	SURVEY	CLUSTER	TROUT 0+	TROUT ≥ 1+	SALMON 0+	SALMON ≥ 1+	SPECIES
	Danescombe stream	Danescombe	SX 4235 6940	15/06/93	1 RUN	AT	43.5	34.3	0	0	E
	St Dominic stream	Morden	SX 4120 6825	10/06/93	3 RUN	-	8.7	29.0	0	0	E

Key: Eel

Summary of electric fishing dipsurvey - Tamar catchment below Gunnislake weir 1995

							POPULATION DENSITIES GIVEN IN NO. FISH / 100m2				OTHER
	RIVER	SITE	NGR	DATE	SURVEY	CLUSTER	TROUT 0+	TROUT ≥ 1+	SALMON 0+	SALMON ≥ 1+	SPECIES
	St Dominic stream	Boresbridge	SX 410 684	20/6/95	Dip	-	P	P	A	A	E
	St Dominic stream	Morden	SX 4120 6825	20/6/95	Dip	-	P	P	A	A	E
	St Dominic stream	Cotehele Mill	SX 417 682	20/6/95	Dip	-	P	P	A	P	E

Key: E-Eel



Note: In viewing the above data the following variables should be considered;

Number of netmen	Efficiency of the nets (materials, mesh size, fishing methods)
Net licence restrictions	Impact of weather (affecting river levels) on netting efficiency

Analysis of Tamar, Tavy and Lynher net catch returns

River Tamar

15 licensed salmon and sea trout net fishermen (including one joint Tamar/Tavy net) fish between Cotehele and the confluence of the Tamar and Tavy estuary. Unusual fish species that have been caught by the netsmen include common carp, common bream (both freshwater species washed downstream), thornback ray, armed bullhead, horse mackerel, smelt, shad species and sea lampreys attached to migrating salmonids (or other marine species such as grey mullet).

The spring run of 2SW salmon has declined significantly since the sixties (spring fish as a percentage of total catch : 1960s - 20%, 1980's - 5%).

Net catches of sea trout were above average 1956-1970 but have since declined to a below average state with very low reported catches 1985-1987.

River Tavy

5 licensed salmon and sea trout net fishermen (including one joint Tamar/Tavy net) fish an area not far below Lopwell Dam. After low salmon catches in the fifties, reported catches rose to a peak in the early seventies and then steadily decreased until the early eighties. Catches since then have remained fairly constant. Peak salmon catches occur in July coinciding with the main run of Grilse into the estuary. These grilse form the main run of Tavy salmon. There has also been a drop in the numbers of spring salmon caught in the nets.

Sea trout net catches reached a peak in the mid sixties before dropping back to more moderate levels from 1969 onwards. Between 1983-1989 net catches fell very low with improved figures in 1992 and 1995.

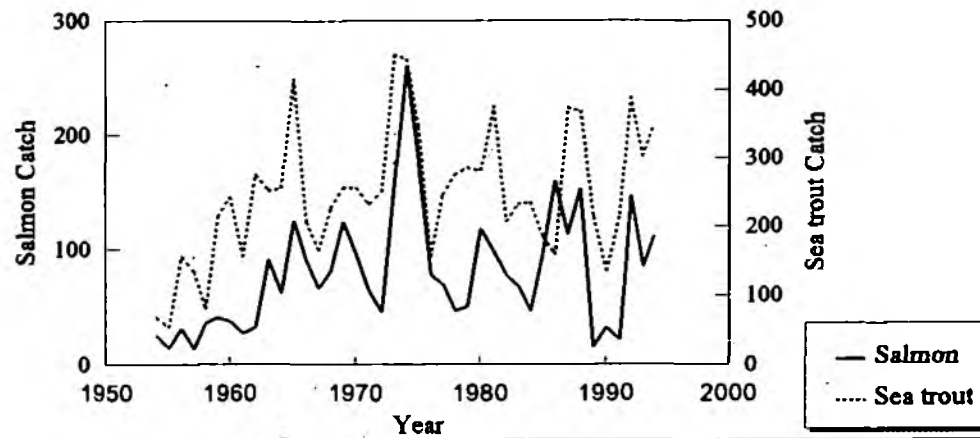
River Lynher

5 licensed salmon and sea trout net fishermen fish within the Lynher Estuary. The catches of larger spring fish which run the river between March and the end of May have fallen significantly since the early eighties and the average catch has also declined since the early eighties. 1995 was the lowest recorded Lynher net catch on record (since 1952) coinciding with a drought year.

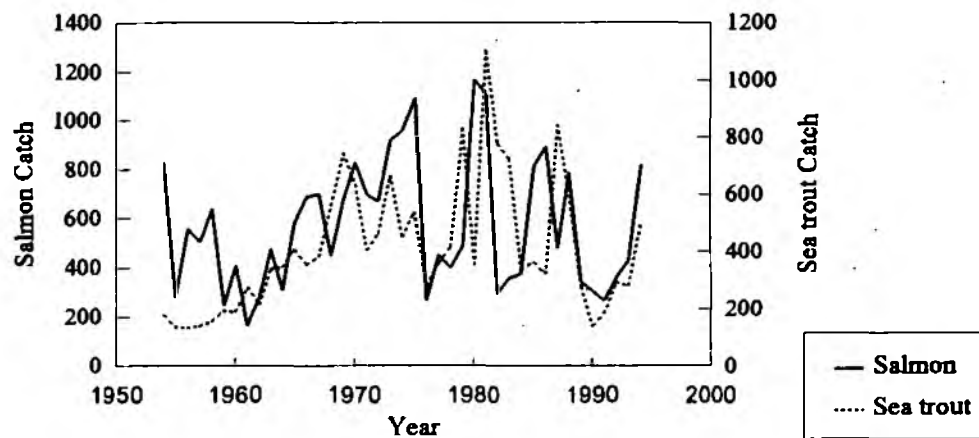
The actual reported catch of sea trout is low in comparison to the rod catch.

A proportion of the salmon and sea trout intending to run the Tiddy will also be caught by the Lynher Estuary nets.

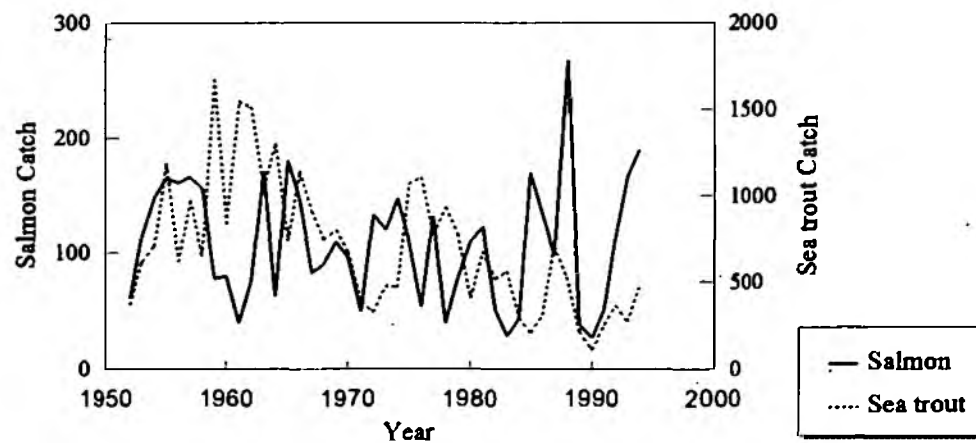
**River Lynher - Rod catches
1954-1994**



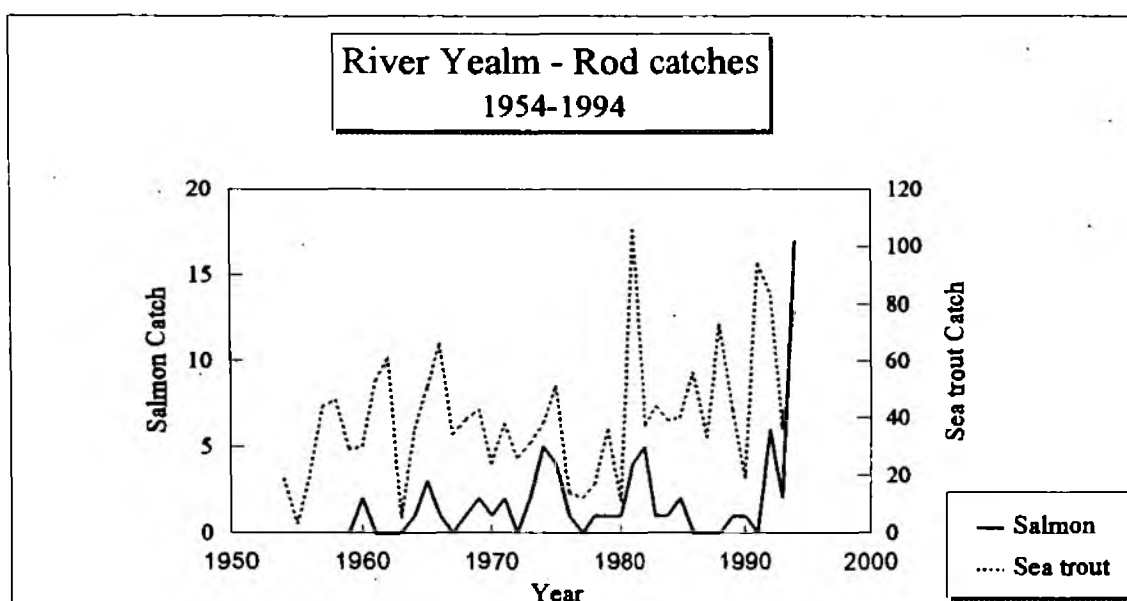
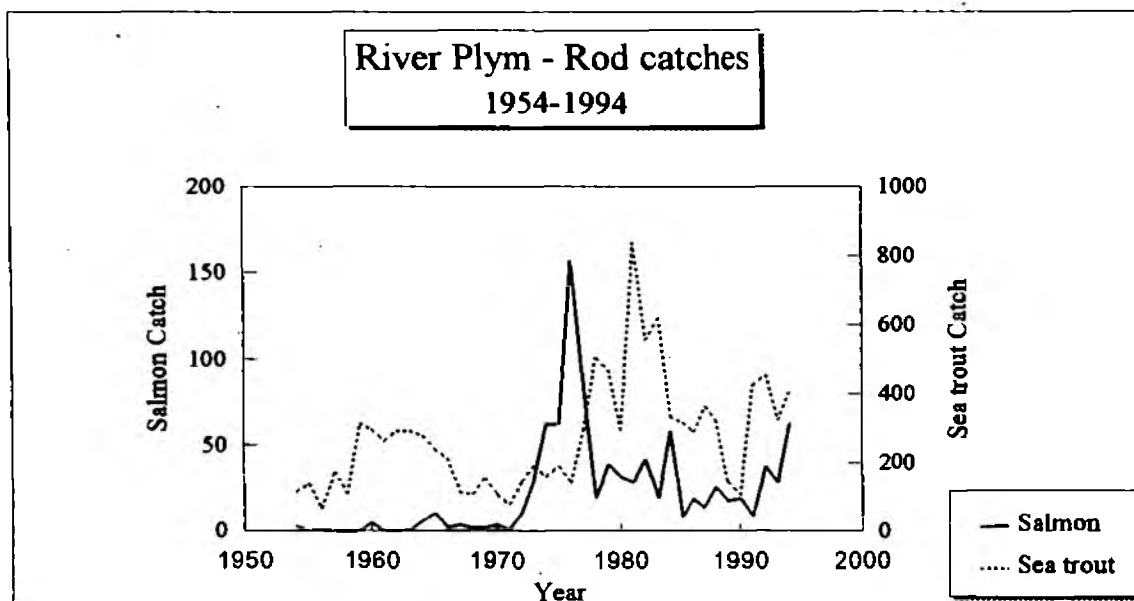
**River Tamar - Rod catches
1954-1994**



**River Tavy - Rod catches
1952-1994**



APPENDIX B



Note: In viewing the above data the following variables should be considered;

- Number of anglers
- Angling effort/efficiency
- Byelaw changes affecting legitimate methods of fishing
- Recent improvements in numbers of catch returns. It is now a legal obligation to make a catch return
- Impact of weather (affecting river levels) on fish catchability
- Licensed nets reduce the number of migratory salmonids available to be caught in freshwater

Changes in rod fishing seasons

- 1972 Plym salmon rod season extended to 15 December from 30 September
- 1973 Lynher/Tamar/Tavy salmon rod season extended to 14 October from 30 September
- 1977 Yealm salmon rod season extended to 15 December from 30 September

Analysis of Tavy, Plym, Yealm and Lynher rod catch returns

River Tavy

The catches of spring salmon (2SW or older) have declined dramatically since the early eighties (spring fish as a percentage of total catch : 1970s - 30%, 1980s - 3%).

Rod catches vary considerably with dry weather adversely affecting fishing success. The highest and lowest rod catches were recorded two years apart (1988 - 267, 1990 - 26). Peak catches generally occur in September although salmon are caught throughout the season.

The extension of the salmon rod season in 1973 has not improved the average annual rod catch which has decreased from 113 (before the season extension) to 104 (after the season extension). A marked decline in the average annual reported rod catch is even more evident if the catch during the October season extension is removed from the annual catch returns. However appreciable numbers of salmon have been caught during October amounting to on average 32% (1973-1994) of the total annual reported catch.

The annual catch of sea trout has varied considerably since 1954 with good returns from 1954-1970, 1975-1983. Intervening periods have shown poor returns. The sea trout catch has on average shown a steady decline since the mid sixties.

River Lynher

The spring run of 2SW salmon has declined significantly since the early eighties (spring fish as a percentage of total catch : 1970s - 30%, 1980s - 15%).

Salmon rod catches were poor between the years of 1954-1962. Catches improved from 1963 with very high catches 1972-1975 (Average 210). Reasonable catches were then reported up until 1988. Poor catches were recorded during 1989 and 1990 which were particularly dry years. Although 1991 was not a dry year reported catch data revealed poor rod and net salmon returns across all four catchments that flow into Plymouth sound. Catches since 1991 have been close to the long term average. The extension of the salmon rod season in 1973 by 14 days has resulted in an increase of 31 rod caught fish annually on average (46% increase in the long term average between 1954-72 and 1973-94).

Monthly salmon rod catches are quite variable with larger catches usually towards the end of the fishing season, in September and October. However in 1969 and 1972 peak catches occurred in May and June. Drought conditions tend to have a strong negative influence on rod catches, largely by inhibiting the upstream migration of adult salmon from saltwater to freshwater.

Catches of sea trout have remained consistent since the early sixties.

The Tiddy is a small river which discharges into the Lynher estuary below Tideford (SX 348 597). It has a very small run of salmon and sea trout which are very occasionally caught by anglers.

River Plym

The trial season extension was to enable anglers to crop the late run of winter salmon which form the majority of the run on the Plym. Catches of salmon taken between 1954 and 1971 were poor. Catches dramatically increased after the season was extended in 1972, peaking in 1976 and then decreasing to a lower but constant level.

Average catch:	1954 - 1971 = 2 salmon/year
Avg. catch:	1972 - 1994 = 39 salmon/year

The annual catch of sea trout has been good since 1954, with an apparent decline around 1971 and then peaking in the early eighties. Catches over the past four years are above average.

River Yealm

The Yealm has a moderate run of sea trout and records minimal salmon catches with the exception of 1994. The low historic salmon rod catches evident from 1959 onwards have continued even after a major season extension in 1977. These results combined with juvenile salmon survey results suggest a small salmon population exists on the Yealm. They do not necessarily indicate that rod fishing effort is low.

The annual catch of sea trout has remained fairly constant since 1954. Sea trout catches in three of the last four years have been higher than average.

APPENDIX B

TAMAR ESTUARY LOCAL ENVIRONMENT AGENCY PLAN NETTING REGULATIONS - AREAS OF RESTRICTION DEVON SEA FISHERIES COMMITTEE Byelaw (19) Prohibiting Netting in Tamar, Plym and Yealm

The local fisheries committee of the Devon Sea Fisheries District by virtue of the powers vested in them by Section 5 of the Sea Fisheries Regulation Act 1966 and Section 37(1) of the Salmon Act 1986 and all other powers them enabling, and with the consent of the Environment Agency, hereby make the following byelaw:

Notwithstanding Byelaw No. 17 no net shall be used for taking fish in any tidal waters inshore of the closing lines specified therein.

1. River Tamar (and its subsidiary estuaries)
All tidal waters inside a line drawn from Devil's Point 225° (True) to Wilderness Point.
2. River Plym
All tidal waters inside a line drawn from the Western End of Mountbatten Pier 000° (True) to Fishers Nose.
3. River Yealm
All tidal waters inside a line drawn 203° (True) from Season Point to Mouthstone Point.

Provided that this byelaw shall not prohibit the use of:

- (a) fyke nets for taking eels, licensed by the National Rivers Authority;
- (b) seine nets for taking salmon or sea trout licensed by the National Rivers Authority;
- (c) landing nets used in conjunction with rod and line, or
- (d) seine nets with a mesh size no greater than 20mm for taking sand-eels in the area described at 3. above.

P.B. Young
Clerk
Devon Sea Fisheries Committee

NATIONAL RIVERS AUTHORITY BYELAW SW6 PROHIBITION OF NETS IN CERTAIN WATERS

The use of any net (not being an authorised fixed engine or a landing net used as auxiliary to angling with rod and line) for taking salmon or trout is prohibited in all waters within the South West Region save that licensed nets may be used for taking salmon and migratory trout -

- (e) in those parts of the public tidal waters of the River Lynher upstream of an imaginary line drawn due south across the river from the southernmost extremity of Wearde Quay;
- (f) in those parts of the public tidal waters of the River Tamar above or to the landward side of the imaginary line drawn straight from the seaward extremity of Devil's Point to the seaward extremity of the landing place near Garden Battery at Mount Edgumbe;
- (g) in those parts of the public tidal waters of the River Tavy upstream of the railway bridge near the confluence with the River Tamar known as the Tavy Bridge.

NOTE:

Sections not relevant to this plan area have been omitted.

Other regulations including mesh size, close times, net material and method of use are available from the Bodmin Fisheries Office.

CORNWALL SEA FISHERIES DISTRICT FIXED ENGINES BYELAW 1987

The Local Fisheries Committee of the Cornwall Sea Fisheries District by virtue of the powers vested in them by Section 5 of the Sea Fisheries Regulation Act 1966 and Section 37(2) of the Salmon Act 1986 and with the consent of the South West Water Authority made the following byelaw on the 10th July 1987.

1. For the purposes of Section 6 of the Salmon and Freshwater Fisheries Act 1975 the use and placing of fixed engines is authorised in the Cornwall Sea Fisheries District subject to the following conditions:
 - (i) The head line of every fixed engine shall be at least 3m below the surface of the water at any state of the tide when set in the following areas less than 1 nautical mile from the low water line along the coast and between the following eastward and westward boundaries:

APPENDIX B

Area (7) Bounded on the East by a line drawn 180 degrees True from Rame Head and bounded on the West by a line drawn 180 degrees True from Hore Stone.

2. For the purpose of this byelaw "fixed engine" has the same meaning as in the Salmon and Freshwater Fisheries Act 1975.
3. This byelaw shall come into operation on the confirmation hereof by the Minister of Agriculture, Fisheries and Food and may be cited as the Cornwall Sea Fisheries District Fixed Engines Byelaw 1987.

NOTE:

Sections and areas not relevant to this plan area have been omitted.

This byelaw does not permit fixed engines to be set in estuaries in Cornwall where the National Rivers Authority has the powers of a Sea Fisheries Committee.

Confirmed by the Minister of Agriculture, Fisheries and Food on the 4th May 1988.

G.K. Burgess

Clerk to the Sea Fisheries Committee

1984 No. 1148

HARBOURS, DOCKS PIERS AND FERRIES

The Dockyard Port of Plymouth Order 1984

SCHEDULE 1 REGULATIONS

Please note that only part of the regulation, that relating to fishing, is described below:

- 5.---- (1) Any person fishing in the Dockyard Port shall comply with any directions given to him by the Queen's Harbour Master.
- (2) No fishing from boats or fishing by persons swimming under the water shall be carried on within 100 metres of the wall, slipways or boundaries of Her Majesty's Dockyard floating docks or other Crown establishments, or within 150 metres of any of Her Majesty's vessels, save with the licence in writing of the Queen's Harbour Master, and in accordance with any conditions attached thereto.
- (3) No fishing shall at any time be carried out within 125 metres of either side of the recommended track or tracks for deep vessels leading through Plymouth Sound to the Hamoaze as shown on current Admiralty Charts or on the line of any electric cable or pipe as described in Regulation 16.
- (4) No trawling or fishing by any nets or long lines, or the laying of lobster or crab pots, marked or unmarked, or the installing of equipment in connection with fish farming shall be carried on in any area in which anchorage is prohibited under Regulation 19.
- (5) All lines used in connection with lobster or crab pots or similar devices shall be non-buoyant, and where any line of pots is less than 100 metres in length, only one end is to be marked.
- (6) In the navigable channels of the Rivers Plym, Tamar, Tavy and Lynher and of Millbrook and St Johns Lakes netting of fish may take place only if:
- (a) the nets are tended by boat throughout
 - (b) sufficient navigable water is left for other craft to navigate the channel.

APPENDIX C

APPENDIX C

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 90%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 CONCERNING THE QUALITY OF BATHING WATERS (76/160/EEC)

MICROBIOLOGICAL STANDARDS

Parameter	Units	Value (1)		Status	
		I	G	I	G
Total coliforms	no/100ml	10,000	500	95% of samples	80% of samples
Faecal coliforms	no/100ml	2,000	100	95% of samples	80% of samples
Faecal streptococci	no/100ml	-	100	-	80% of samples
Salmonella	no/l	0	-	All samples	-
Enterovirus	PFU/10l	0	-	All samples	-

PFU = Plaque Forming Units

Notes: (1)

I = Imperative or Mandatory standard

G = Guideline standard

APPENDIX C

Table 2 continued:

AESTHETIC CRITERIA

Parameter	Analysis Method	Description/Standard
Colour	Visual inspection	No abnormal change
Mineral oils	Visual inspection	No visible surface film
	Olfactory inspection	No odour
	mg/l after extraction and weighing dried residue	≤0.3
Surface-active substances (methylene-blue active)	Visual inspection	No lasting foam
	mg/l as lauryl sulphate	≤0.3
Phenols	Olfactory inspection	No specific odour
	mg/l	≤0.05
Transparency	m	1
Tarry residues, solid floating material, effluent slicks	Visual inspection	Absent

TABLE 3: EC DANGEROUS SUBSTANCES DIRECTIVE ON POLLUTION CAUSED BY CERTAIN SUBSTANCES DISCHARGED IN THE AQUATIC ENVIRONMENT OF THE COMMUNITY, (76/464/EC)

Please Note : Only Environmental Quality Standards (EQSs) for those substances which are described in the text are given. A full list of standards covered by this EC Directive is available from the Environment Agency on request

EQSs FOR LIST I SUBSTANCES (INLAND WATERS)

Parameter	Units	Value	Status (1)
Cadmium (2)	µg Cd/l	5.0	AA,T
		1.0	AA,T,B (4)
Hexachlorocyclohexane (HCH) (2)	µg/l	0.1	AA,T
		0.05	AA,T,B (4)

EQSs FOR LIST I SUBSTANCES (TIDAL WATERS)

Parameter	Units	Value	Status (1)
Cadmium (2)	µg Cd/l	2.5	AA,D
Hexachlorocyclohexane (HCH) (2)	µg/l	0.02	AA,T

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

Table 3 continued

Parameter	Units	Value (3)		Hardness (mg CaCO ₃ /l)	Status (2)
		A Std	B Std		
Zinc	µg Zn/l	8 50 75 75 75 125	75 175 250 250 250 500	0 to 50 50 to 100 100 to 150 150 to 200 200 to 250 >250	AA,T
Copper	µg Cu/l	1 6 10 10 10 28	1 6 10 10 10 28	0 to 50 50 to 100 100 to 150 150 to 200 200 to 250 >250	AA,D
Nickel	µg Ni/l	50 100 150 150 200 200	50 100 150 150 200 200	0 to 50 50 to 100 100 to 150 150 to 200 200 to 250 >250	AA,D
pH	pH values	6 to 9		All	95% of samples
Tributyltin	µg/l	0.02		All	M,T

EQSs FOR LIST II SUBSTANCES (TIDAL WATERS)

Parameter	Units	Value (1)	Status
Zinc	µg Zn/l	40	AA,D
Copper	µg Cu/l	5	AA,D
Nickel	µg Ni/l	30	AA,D
pH	pH values	6 to 8.5 (3)	95% of samples
Tributyltin	µg/l	0.002	M,T

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

Please Note : Only standards for those substances which are described in the text are given. A full list of standards covered by this EC Directive is available from the Environment Agency on request.

DETERMINAND	SALMONID WATERS		CYPRINID WATERS	
	G	T (1)	G	T (1)
pH as pH units	-	6.0-9.0	-	6.0-9.0
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
Zinc (Total) as mg/l Zn	-	-	-	-
Water Hardness (mg/l CaCO ₃)	0-50	0.03	-	0.30
	50-100	0.20	-	0.70
	100-250	0.30	-	1.00
	>250	0.50	-	2.00

(1) For the substances shown in this table, guidance from the Department of the Environment (DoE) states that 11 out of 12 samples collected monthly during a calendar year must meet the Imperative standards.

TABLE 5: EC DIRECTIVE CONCERNING THE QUALITY REQUIRED OF SURFACE WATER INTENDED FOR THE ABSTRACTION OF DRINKING WATER IN THE MEMBER STATES (75/440/EEC)

Please Note : Only standards for those substances which are described in the text are given. A full list of substances and standards is available from the Environment Agency on request.

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

CHARACTERISTICS OF SURFACE WATER INTENDED FOR THE ABSTRACTION OF DRINKING WATER			CATEGORIES					
			A1		A2		A3	
			G	I	G	I	G	I
2	Coloration (after simple filtration)	mg/l Pt scale	10	20 (O)	50	100 (O)	50	200 (O)
10	Dissolved Iron	mg/l Fe	0.1	0.3	1	2	1	-
31	Phenols (phenol index) paranitraniline 4 aminodipyrine	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

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TABLE 6: EC DIRECTIVE LAYING DOWN THE HEALTH CONDITIONS FOR THE PRODUCTION AND PLACING ON THE MARKET OF LIVE BIVALVE MOLLUSCS (91/492/EC)

END PRODUCT STANDARD

- * Must be fresh and alive (response to percussion)
- * must contain <300 faecal coliforms or <230 *E.coli* per 100g shellfish flesh
- * no salmonella in 25g of flesh
- * no toxic or objectionable compounds such as those listed in Directive 79/923/EEC
- * Paralytic Shellfish Poison must not exceed 80 µg per 100g of flesh
- * Diarrhetic Shellfish Poison must not exceed 'dangerous levels'
- * provision for a future virological standard
- * provision for revision of bacteriological standard

CLASSIFICATION OF HARVESTING AREAS

<u>Category A</u>	<230 <i>E.coli</i> /100g <300 faecal coliforms/100g	flesh may go for direct human consumption
<u>Category B</u>	<4600 <i>E.coli</i> /100g <6000 faecal coliforms/100g (in 90% of samples)	must be depurated, heat treated or relaid to meet category A
<u>Category C</u>	<60,000 faecal coliforms/100g	must be relaid for long periods (2 months) to meet Category A or B (may also be heat treated by approved method)
<u>Category D</u>	above 60,000 faecal coliforms/100g or at discretion of Member State	Prohibited

TABLE 7: 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	
Tiifluralin	

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 C

TABLE 8: TYPICAL RANGE¹ OF TRACE METALS AND ORGANOHALOGEN CONCENTRATIONS IN MOLLUSCAN SHELLFISH FROM ENGLAND AND WALES

	mg kg ⁻¹ Dry Weight							µg kg ⁻¹ Wet Weight			
	Hg	Cd	Pb	Cr	Zn	Cu	As	DDT	Dieldrin	HCH	PCBs
Oyster ² Whole	<0.1- 1.8	<1-9	<1-8	<1-3.5	425- 3500	50-400	-	<5-100	<1-50	<1-10	<10- 500
Mussel Whole	<0.1- 2.2	<1-10	2.5-20	<1-8	50-450	5-16	4.5-15	<5-200	<1-50	<1-20	20- 500

Notes: 1: Based on data from MAFF surveys during recent years from "Implementation of the EC Shellfish Waters Directive", March 1994, NRA, Water Quality Series No. 16.
2: Pacific and Native

TABLE 9: WATER QUALITY TARGETS TO PROTECT MIGRATORY SALMONID FISHERY USE IN ESTUARIES¹

Parameter	Units	Value	Status ²	Comments
Dissolved Oxygen	mg/l	5.0 3.0	P MIN	
Unionised Ammonia	mg N/l	0.021 0.25	AA, TA MAC	1. Tidally averaged during periods of salmon migration 2. Max pH = 8.2 for calculation of UIA

Notes: 1: From "AMP2 Guidelines, Version 2", Approved by the Quadripartite Meeting 14/12/93

2: P = 95%ile
MIN = absolute minimum
AA = Annual average
TA = Tidally averaged during periods of salmon migration
MAC = Maximum Allowable Concentration

APPENDIX D Flood Defence Maintenance - standards of service

Land use factors

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

APPENDIX D**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>

APPENDIX E

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 Environment Agency 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 Environment Agency 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.

APPENDIX E

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 F

South West Water Abstractions

Name and NGR	ML/ Daily	ML Annual	Conditions
Wheal Lucky Adit SX 570 750 Mt View Springs SX 571 753 Wheal Lucky Spring SX 571 751	0.34	122.7	
Witheybrook Bastreet SX 244 765	9.09	3318.6	Prescribed flow of 0.02 m ³ /s. May take 9.09 ML/d plus any quantity put into the Brook from Sibilyback Res. Provided that if flow over weir is less than 9.09 ML/d only 4.55 ML/d is taken. E.C.W.B. Order 1965. In aggregate with abstraction from the River Fowey at Trekeivesteps 6273.6 ML per year
River Tavy at Lopwell SX 475 650	91	33215.0	Prescribed flow below Lopwell of 0.845 m ³ /s. When flows higher than prescribed flow, 50% of excess water may be abstracted. Effective from 7.9.89
Burrator Reservoir SX 551 680	90.9	29549.4	Compensation release of 0.030 m ³ /s. In aggregate with Devonport Leat Intake shall not exceed 33186.3 ML per year.
Devonport Leat (Dousland Intake) SX 550 683	22.7	8182.9	In aggregate with Burrator Res. shall not exceed 33186.3 ML per year.
River Yealm SX 617 620 Broadall Lake SX 613 620 Ford Brook SX 612 618	4.6	1136.5	Prescribed flows: River Yealm 0.017 m ³ /s Broadall Lake 0.007 m ³ /s Ford Brook 0.003 m ³ /s Plympton St Mary R. D.C Act 1928
River Meavy SX 574 714	9.1	3318.6	This is a gravity fed fixed pipe abstraction upstream of Burrator reservoir that augments Devonport Leat.

APPENDIX F

Breakdown of all abstractions in the Tamar Estuary and Tributaries catchment

Quantities: m³/year		YEALM		PLYM		Tidal LYNHER		Tidal TAMAR		TAVY		WALKHAM		LYNHER		TIDDY		TOTALS
		No	Quantity	No	Quantity	No	Quantity	No	Quantity	No	Quantity	No	Quantity	No	Quantity	No	Quantity	
AGRI-CULTURE	G	39	81084	14	25406	15	22879	55	102115	55	89648	8	9532	51	81991	16	27217	439872
	S	1	498	3	3933					4	3214	1	543	1	6504			14692
SPRAY IRRIGATION	G			1	3273			5	13218	1	191			3	18119			34801
	S	3	25908	1	1818	5	91118	5	12443					5	19502	2	15459	166248
PISCI-CULTURE	G																	0
	S							1	6636	4	12224850			1	345			12251831
INDUSTRIAL	G	2	752462	6	2409158	1	118			1	1136			1	332			3163206
	S	2	477341	7	6993520					2	3823			1	182			7474866
HYDRO-POWER	G									1	17672							17672
	S							1	268270					3	46623166			46891436
OTHER PRIVATE	G	11	23944	6	4859	5	5109	13	77058	9	10177	3	2918	7	9529	2	2438	136032
	S	1	197830	4	2799			1	10142	2	1702412	4	2394					1915577
SWWSL PUBLIC SUPPLY	G											1	122740					122740
	S	1	1136500	3	41050960					1	33215000			1	3318580			78721040
NATIONAL POWER LEAT	G																	0
	S									2	75009765							7500976
		60	2695567	45	50495726	26	119224	81	489882	82	122277888	17	138127	74	50078250	20	45114	226339778

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
Ml/day}	Megalitres per day (Ml = 1,000,000 litres)
Ml/d }	
Ml/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
ppb	Parts per billion

ABBREVIATIONS

AGHV	Area of Great Historic Value
AGLV	Area of Great Landscape Value
AGSV	Area of Great Scientific Value
AMP2	Asset Management Plan 2
AONB	Area of Outstanding Natural Beauty
ASPT	Average Score per Taxon
BATNEEC	Best Available Techniques Not Entailing Excessive Cost
BCU	British Canoe Union
BMWP	Biological Monitoring Working Party
BOD	Biochemical Oxygen Demand
BPEO	Best Practicable Environmental Option
CAU	Comwall Archaeological Unit
CBWPS	Comwall Birdwatching and Preservation Society
CoCo	Countryside Commission
CLA	Country Landowners Association
CMP	Catchment Management Plan
CNC	Comwall Nature Conservation Site
CPRE	Council for the Protection of Rural England
CRI	Chemical Release Inventory
CSFC	Comwall Sea Fisheries Committee
CWT	Comwall Wildlife Trust
DAU	Devon Archaeological Unit
DCC	Devon County Council
DML	Devonport Management Limited
DNP	Dartmoor National Park
DoE	Department of the Environment
DSFC	Devon Sea Fisheries Committee
DWT	Devon Wildlife Trust
EA	Environment Agency
EC	European Commission
ECCL	English China Clay International
EN	English Nature
EPAQS	Expert Panel of Air Quality Standards
EQS	Environmental Quality Standard
ESA	Environmentally Sensitive Area
EU	European Union

FWAG	Farming and Wildlife Advisory Group
GQA	General Quality Assessment
GIS	Geographical Information System
HE	House Equivalent
HMIP	Her Majesty's Inspectorate of Pollution
IPC	Integrated Pollution Control
LEAP	Local Environment Agency Plan
LOE	Licence of Entitlement
LPA	Local Planning Authority
LTA	Long Term Average
MAFF	Ministry of Agriculture, Fisheries and Food
MoD	Ministry of Defence
MoU	Memorandum of Understanding
NCZ	Nature Conservation Zone
NFU	National Farmers Union
NGR	National Grid Reference
NRA	National Rivers Authority
NT	National Trust
NWC	National Water Council
OFWAT	Office of Water Services
PPG	Planning Policy Guidance
R&D	Research and Development
RE	River Ecosystem, RE1, RE2, etc.
RHS	River Habitat Survey
RIVPACS	River Invertebrates Prediction and Classification System
RQO	River Quality Objective
RSPB	Royal Society for the Protection of Birds
SAC	Special Area of Conservation
SAFA	Salmon and Freshwater Fisheries Act
SAGLV	Special Area of Great Landscape Value
SAM	Scheduled Ancient Monument
SFC	Sea Fisheries Committees
SLINC	Site Locally Important for Nature Conservation
SPA	Special Protection Area
SSO	Storm Sewer Overflow
SSSI	Site of Special Scientific Interest
STW	Sewage Treatment Works
SWQO	Statutory Water Quality Objective
SWW	South West Water
TBT	Tributyltin
TON	Total Oxidised Nitrogen
UWWTD	Urban Waste Water Treatment Directive
WDBC	West Devon Borough Council
WHO	World Health Organisation
WQO	Water Quality Objective
WRA	Waste Regulation Authority
WTW	Water Treatment Works

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