



1974-96

Modern History of the RIVER DON Catchment

The insidious damage which the demands of man had imposed upon the natural environment of the Don system gained momentum throughout the centuries. This progressive destruction had almost reached its peak by the turn of the 19th Century leaving the river and most of its tributaries severely damaged. Little remained of the diverse ecosystem which once existed and in its place was an open sewer carrying away the filth created by industry and its servants. Although attempts were made to stem the destruction, little changed over the following seventy years, other than the addition of a more complex array of polluting material.

With the river in such a severely degraded physical and chemical condition, it is perhaps understandable that the work carried out to protect against flooding during the period 1934-51 on the Don and later on the Dearne and Rother, took little account of the catchments future potential for rehabilitation, though it did compound the rivers sad situation.

It was in this chronically degraded condition that in April 1974 the responsibility for managing the Don system passed into the hands of the newly formed Yorkshire Water Authority. This new organisation had for the first time the opportunity to apply a more holistic approach to the management of rivers. In addition to assuming responsibility for water supply and sewage disposal, the new Authority encompassed responsibility for pollution control, water resource management, flood defence and fisheries.

For the staff appointed to deal with water quality problems in particular, the prospects could hardly have been more daunting. It was not without justification that the Don was commonly referred to as one of Europe's most polluted rivers.

The following chapters describe the progress that has been made since 1974. Again it uses fish populations as a guide and charts how, through natural recolonisation and reintroduction, fish populations have mirrored the water quality improvements which have been achieved over the 22 year period to 1996.

To complete the picture, overviews of the work carried out to protect against flooding, manage water resources, control pollution and enhance and protect the re-emerging ecosystem are included together with a description of the opportunities that a cleaner River Don offers for recreation.



*WINSCAR RESERVOIR
Built to replace the smaller Dunford Bridge
Reservoir in the 1970's. It serves as a
compensation reservoir which provides the base
flow to the upper River Don*

PART 2- CHAPTER 1

THE REHABILITATION OF FISH POPULATIONS DON HEADWATERS TO THE RIVER DEARNE

By April 1974 what remained of the Don's once proud fish stocks had been reduced to a small number of brown trout isolated in a few upstream locations.

Of particular significance was the population which existed in the upper Don system between Bullhouse and Dunford Bridge. This part of the river had to endure the damage caused by severe siltation during the construction of Winscar Reservoir yet despite the loss of almost all of the natural spawning gravels a small number of wild brown trout had managed to survive. It was the presence of this population which was to provide the incentive for the first attempt at restoring the River Don as a fishery.

Early in 1975 the Yorkshire Water Authority received an application for a licence to abstract 113652m³ (25 million gallons) of water per day from the Don at Hazlehead. As is legally required, the application was advertised and as a result came to the attention of the local branch of the Salmon and Trout Association who requested their local organiser, Mr Gerald Stocks, to assess the potential impacts.

The investigation carried out by Gerald Stocks identified the presence of trout and also revealed that the section of river offered considerable potential for development as a recreational fishery and on the strength of these findings the association lodged an objection to the application.



*DON AT HAZLEHEAD
Part of the Don which was developed as a trout
fishery by the Salmon & Trout Association in the
1970's*

Despite the objection a licence was eventually granted but for a lesser amount of 68191m³ (15 million gallons) per day but strict conditions were applied which ensured that most of the water after use was returned to the river in a condition which would not significantly alter quality. Encouraged by this the Salmon and Trout Association acquired fishing rights and more importantly the support of land owners in undertaking a restoration programme on this upper section of the Don. Help and support was also forthcoming from the Fisheries department of the Yorkshire Water Authority who initially set about addressing the problems of siltation. Flushes of water were released from Winscar Reservoir which helped to disperse accumulated silt from spawning

gravels and in addition work was carried out to improve the quality of the effluent from a small sewage treatment works at Dunford Bridge.



*BROWN TROUT RELEASE
Releasing brown trout into the upper
Don to assist in the development of
the fishery*

The benefits of this work were quickly recognised and on 10 October 1975 the first introduction of fish to assist in the redevelopment of the Don fishery was delivered to Hazlehead. The consignment which consisted of 250 brown trout of between 12.5-30.5 cm (5 to 12 inches) in length was provided by the Yorkshire Water Authority.

Over the following 5 years various habitat improvement schemes were carried out along sections of the Don between Hazlehead and Penistone and despite chronic and persistent problems associated with ochreous discharges from long abandoned mine workings and other industrial and agricultural practices, the trout population rapidly improved in both quality and quantity.

To record their efforts, the Salmon and Trout Association produced a report which graphically described the environmental degradation which they encountered during their restoration work. This document includes the following lists which helps to illustrate the conditions.

FORMS OF POLLUTION

- 1 Iron Hydroxide (ochre)
- 2 Detergents (foaming)
- 3 Oil
- 4 Offal
- 5 Salt
- 6 Sewage

REFUSE REMOVED FROM THE RIVER INCLUDED

- 1 Corrugated sheeting
- 2 Prams
- 3 Car bodies
- 4 Metal drums and crates
- 5 Tyres

**GRAYLING**

This species was re-introduced to the Don system in 1984 after almost a 150 year absence

**CHEESEBOTTOM STW**

The first large sewage treatment works on the River Don near Penistone. Improvements to this works in the late 1970's allowed the fishery downstream to begin its recovery.

By 1983 with the future of the brown trout population on the upper Don apparently assured, the Salmon and Trout Association following discussions with Yorkshire Water Fisheries department, turned its attention to the re-establishment of the Don's once prolific grayling population. A stock of this species was available from cropping operations carried out by the Authority on the West Beck near Driffield and a decision was taken to release 200 fish into the river at Hazlehead. The extremes of environment, from the gentle flow of a chalk stream to the harsh and volatile conditions of a Pennine spate stream could not have been greater, yet despite this the fish survived. Indeed their adaptation to their new environment was remarkable. Within 4 months of their release a number of the larger mature specimens reproduced in the Don and their progeny began the recolonisation of sections both up and downstream of the original introduction point.

The development of this population was extremely rapid and within 3 years the species was being recorded in fishery surveys from sites some 15 kilometres (9¹/₄ miles) below the release point.

This downstream recolonisation process continued throughout the next decade with stocks progressively edging further towards the centre of Sheffield. This movement to a great extent mirrored the improvements being achieved in water quality and by 1995 grayling had been confirmed as far down as the Don's confluence with the River Sheaf.

CHEESEBOTTOM STW - CASE STUDY

Toward the end of the 1970's in the upper part of the River Don catchment, around the Penistone area, sewage was treated at one of 5 sewage treatment works: Green Moor, Oxspring, Thurgoland, Thurlstone and Spring Vale. All 5 works produced poor quality effluent and Thurlstone afforded little better than primary treatment. The flow was allowed to settle in shallow lagoons, and then passed over an old ash tip and then to the river.

The following table shows the mean values for BOD, SS and NH₃ for the final 3 years discharge quality prior to the works closure:

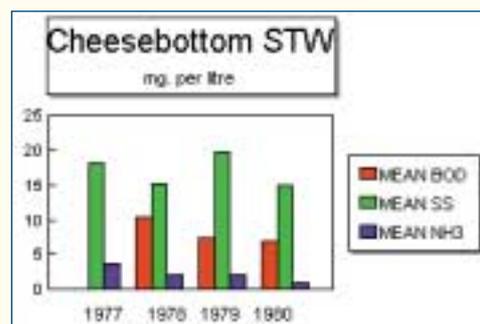
Works	BOD	SS	NH ₃
Green Moor	64	87	39
Oxspring	65	117	23
Spring Vale	116	120	30
Thurgoland	101	120	17
Thurlstone	55	64	15

Green Moor, Oxspring and Thurgoland were relatively small works, where as Spring Vale and Thurlstone served the Penistone conurbation. These works were inherited by Yorkshire Water Authority on its inauguration in 1974 and to remedy the situation the Authority commissioned the building of a brand new works at Cheesebottom to replace these 5 works. The works started discharging in 1977 and the following table gives some idea of the works first few years performance.

Early Performance of Cheesebottom STW

YEAR	MEAN BOD	MEAN SS	MEAN NH ₃
1977	-----	18.3	3.7
1978	10.4	15.3	2.1
1979	7.3	19.7	2.1
1980	7.0	15.0	0.9

All analysis in mg.l⁻¹



Along the upper river between Penistone and Oughtibridge remained several of the disused dams which had provided the supply to the water wheels of the mills and grinding operations during the industrial development of the valley. Several of these were developed as coarse fisheries by local angling interests in the 1960's and early 1970's and as a result they began to feed small numbers of fish, principally roach and perch into the river via their outlets. The ability of the fish to survive encouraged angling interests to attempt to develop the river as a coarse fishery by transferring excess stock from the dams. To some extent this proved successful particularly in the ponded conditions around the weirs.

However, in terms of an environment suitable for natural maintenance of coarse fish populations the river at this point was generally unsuitable having a topography more suited to trout. A considerable proportion of the stocked fish introduced in these exercises drifted downstream often during flood flow conditions and as water quality improvements continued, began to form the nucleus of the developing populations of coarse fish in the river in and around Sheffield.



THE DON AT OXSPRING
Coarse fish were introduced to the river in this vicinity but the environment of the river was more suited to trout

Similar use of disused dams as coarse fisheries had occurred on many of the tributaries including the Rivelin and Loxley and fall out of stock from these streams also contributed.

The first appreciable concentration of coarse fish to develop in the Don within the City of Sheffield occurred downstream of the confluence with the River Loxley in the early 1980's. The diluting effect of the Loxley's flow helping ameliorate the conditions in the main river sufficiently for their short term establishment and survival. Increasingly these populations began to spread, with further concentrations beginning to occur below the numerous weirs which provided slightly improved conditions due to their aerating effect.

Fishery survey results obtained from an operation carried out in October 1984 showed a small fish population consisting of roach, gudgeon and minnows downstream of Lady's Bridge which suggested better conditions than indicated by the rivers chemical classification at that point.

Despite these encouraging signs it was clear that the larger coarse fish species did not represent a self sustaining population and that the fish present were generally the product of still water reproduction. This could often be confirmed by scientific examination which revealed the presence of parasites normally associated with still water conditions.

Throughout the 1980's the closure of traditional heavy industries, the introduction of more stringent consent conditions on dischargers and the development of the Don Valley trunk sewer progressively resulted in improving water quality along the section of the Don between the mouths of the Loxley and Sheaf. This improvement was reflected by the first evidence of self sustaining populations of minnows towards the end of the decade, with growing populations of roach, perch and gudgeon maintained by continued fall out from upstream fisheries.

DON VALLEY INTERCEPTOR SEWER - CASE STUDY

(The development of this system contributed significantly to the improvements in water quality which allowed the rehabilitation of fish populations throughout Sheffield.)

The earliest trunk sewers serving Sheffield were laid in the early 1880's with further major works carried out in 1910. The sewers conveyed both foul and storm sewage along the valley of the River Don to Blackburn Meadows at the eastern end of the city where the first treatment plant was opened in 1886. At the time of construction they were of sufficient capacity to serve the flows from the city. Relief was provided by the provision of storm sewage overflows which discharged directly to the river in wet weather.

Since the last century, Sheffield has grown in size, industry has expanded and the usage of water increased such that the original sewers became overloaded and excessive quantities of sewage discharged to river in only light rainfall and sometimes even in dry weather. Inadequate sewerage also lead to localised flooding to properties in low lying areas.

In the 1960's the City Council became increasingly concerned with the condition and operation of the main sewers. They found the structure of the sewers were deteriorating and such inspections that they could make, revealed that it would be unreasonable to expect the system to remain in use for many more years without major reconstruction. Works investigating a practical and economic solution to the problem were commenced. The solution was to tunnel a new sewer in the Carboniferous strata. The new sewer would serve the inner part of the Sheffield drainage area and would result in 26 large unsatisfactory storm sewage overflows being abandoned.

The initial contract was let in 4 phases and work on Phase 1 commenced in 1979. This involved laying 2.14km (1¹/₃ miles) of tunnelled main sewer with an internal diameter of 5.5m (6 yds) to a drop shaft in Hawke Street. It also included the building of a new pumping station and associated works at Blackburn Meadows. This first stage was completed by July 1983.

Phase 2 commenced in the autumn of 1983 and involved driving a 2.23km (1¹/₂ miles) length of sewer with a diameter of 3.81m (4 yds) towards a drop shaft next to Furnival Road in the centre of Sheffield.

Phase 3 was concerned with a stretch of sewer from Furnival Road to the Whitbread Brewery with a small section commencing at the Sheaf valley sewer towards the central bus station.

Phase 4, completed in 1993, extended the Don Valley sewer to Gilpin Street.

Section 5A has recently been completed and extends the sewer from Gilpin Street to Livesey Street, Hillsborough.

Two further sections of the interceptor sewer are still necessary, i) extension to the Sheaf Valley sewer to Millhouses, and ii) extension to the Don Valley sewer to the Sheffield Wednesday Football Ground, to include a Loxley trunk sewer leg to Malin Bridge. To date no decisions have been taken about when this work will commence.

Also beginning to appear below the weirs in Sheffield were dace and chub. These fish owed their origin to restocking work carried out by the YWA and by local angling interests in the Wortley area in 1988. The fish used for the stocking were some of the first to become commercially available from experimental breeding of riverine species carried out by the Yorkshire and Severn Trent Water Authorities at their sites at Aldwarke and Calverton during the late 1980's.

Encouraged by the improving conditions Yorkshire Water Fisheries staff commenced a series of coarse fish introductions during 1987-88 using fish obtained from a number of local still waters. The stock introduced consisted principally of small roach, perch and bream which had been removed from their parent water because of overstocking problems. One such water was Herries Road Pond at Hillsborough which provided more than 5000 fish. Stock from such sources were far from ideal for river re-development, the fish were often stunted and in generally poor physical condition and in addition lacked the muscle development inherent in fish bred in flowing water conditions.



*HERRIES ROAD POND
Surplus fish were netted from this and other waters in the
1980's to assist the re-establishment of fish populations in the
River Don throughout Sheffield*

Being so disadvantaged many of the fish were quickly carried downstream once subjected to the flowing conditions of the river. Many eventually found slack water areas off the main channel particularly where the river linked into the South Yorkshire Navigation so beginning the development of the fishery in this system. Most of the fish introduced around this period were released close to the confluence of the River Loxley. This point was chosen to take advantage of the diluting effects of the cleaner flow of the tributary. Despite the downstream displacement, some of the introduced stock did gradually adapt to life in the river and provided good catches for a time to some of the more adventurous anglers who were beginning to recognise the river's developing potential.

The main breakthrough came in 1989 when large numbers of riverine stock, including roach, chub, dace and barbel became available from the Severn Trent Water Authority's Calverton Fish Farm. This facility pioneered the supply of hatchery reared fish which had been entrained to flowing water conditions on the farm before delivery. (The fish are placed in tanks and gradually subjected to an increasing flow which helps to develop the tail muscles.)

The first large scale stocking using this supply occurred on 11 January 1990 when a grant of 2,000 chub and 2,000 dace was made to assist the river's recovery by the newly privatised Yorkshire Water PLC. Introduced between Salmon Pastures and Meadowhall in Sheffield the fish very rapidly adapted to their new environment, clearly demonstrating the benefits of flow entrainment by the numbers which took up residence close to the introduction points.

By 1990 the presence of juvenile gudgeon and roach in the river throughout Sheffield was indicating that a self sustaining coarse fish population was becoming well established. However, below the City's main sewage treatment works at Blackburn Meadows the picture was far from encouraging. Poor water quality continued to limit the population to small numbers of fish which had dropped downstream following stocking operations. Their progress down to the confluence with the Rother at Rotherham was usually rapid as they tried to escape the almost intolerable conditions. Suddenly on reaching Rotherham the fish found their progress blocked by the even more extreme conditions created by the grossly polluted waters of the Rother.

Fish population surveys carried out in 1987 and again in 1990 located large concentrations of fish, predominantly roach just above the Rother confluence which showed indications of having originated from still water sources. Many undoubtedly owing their origin in the river to the restocking work described earlier. These concentrations naturally attracted angler attention and from this source of information it was possible to monitor through catch reports the way that the fish reacted to changing conditions. It was clear that during



DISCHARGE FROM BLACKBURN MEADOWS STW
Serving the city of Sheffield, it is the largest STW in the
Don catchment

periods of low flow the numbers of fish present continued to build, whilst during a flood, (which provided some measure of dilution to the polluted Rother,) many of the fish continued their downstream movement.

By 1994 significant improvements had been achieved in the quality of the effluent from Blackburn Meadows Sewage Treatment Works as a result of a major modernisation of the plant. The most toxic component was ammonia and it was imperative that the new STW reduced the levels. Following completion of the improvement scheme the mean concentrations of ammonia leaving the works dropped dramatically from their 1991 level of 18.9 milligrams per litre to 2.4 milligrams per litre by 1994. Meanwhile conditions were also improving in the River Rother. The benefits of these improvements on the Don below Rotherham through to its confluence with the Dearne were not long in being realised as fish populations quickly began to build.

BLACKBURN MEADOWS STW - CASE STUDY

The first sewage treatment facilities to serve the city of Sheffield were built in 1886, at Blackburn Meadows, adjacent to what is today, the Meadowhall Shopping Complex.

Originally, the works operated on a lime precipitation process, plus aeration over a series of weirs and finally coke filtration. By today's standards, the treatment was extremely crude and had no facilities to deal with storm flows. Despite this it was considered a 'model' when constructed and was visited by interested parties from all over Britain.

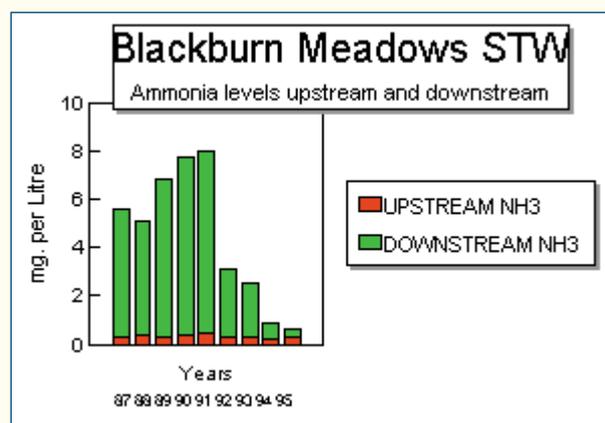
In 1910 as a result of increasing pressure from the local Government Board and the West Riding Rivers Board, the plant was remodelled with the intention of introducing extensive bacteria beds. These were finally brought into operation in 1914.

It is interesting to note that the City Council before commencing these improvements actually considered, as an alternative, piping the sewage all the way to the North Sea.

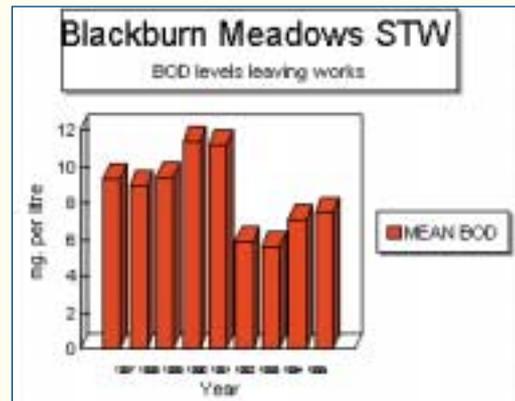
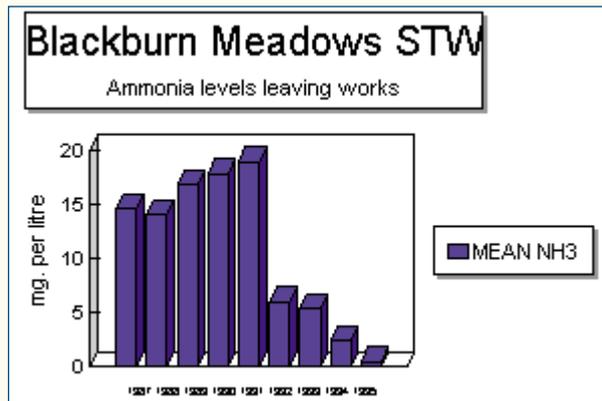
In 1916 the then manager of Sheffield's Sewage Disposal Department, Mr John Howarth, developed the Sheffield aeration system which was finally introduced at the works in 1932. This system became the role model for sewage treatment throughout the Sheffield area and was adopted by several other local councils. This system proved effective in treating the Biochemical Oxygen Demand but poor at removing ammonia (NH₃). As a result, the works regularly discharged effluents which contained ammonia levels in excess of 20 mg/litre. In later years as the volume of effluent in relation to river flows increased due to greater public use of drinking water the dilution factor would often in summer drop as low as 1.1 (one part effluent to one part river water) giving an ammonia level in the river below the discharge of 10 mg/l.

In 1992 work began on major improvements to the works which included the introduction of a modern system utilising a series of anoxic zones and diffuse air activated sludge treatment.

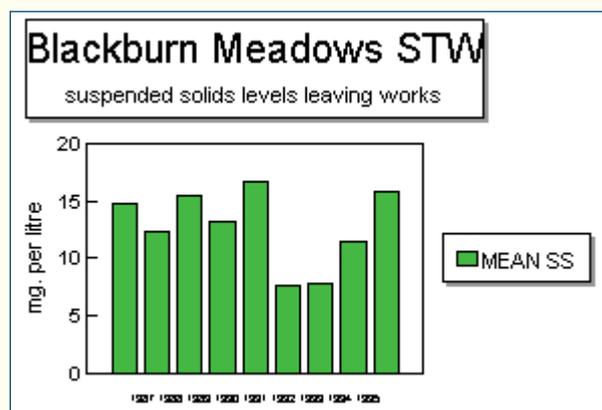
The benefits of this investment are clearly demonstrated on the chart below which shows a massive reduction in the mean levels of ammonia between 1987 and 1995.



Free ammonia is a powerful organic poison which is lethal to fish in quite small doses. The toxicity of this contaminant is increased by a rise in the pH value of water and by temperature. The smaller the fish, the more sensitive it is to ammonia. At concentrations as low as 0.2-0.4 mg/ltr it can destroy fish fry, at 0.6 mg/ltr it can kill small fish and at between 1-2 mg/ltr few fish are able to tolerate it. It was the decrease in ammonia levels which had the most beneficial effect on the developing fishery of the Don system.



Over the following two years the development of these populations was assisted by further restocking carried out by the National Rivers Authority and by introductions made by angling interests to the South Yorkshire Navigation in the Swinton/Mexborough area. By the end of 1996 the section of river between Rotherham and Mexborough had become established as one of the most popular locations for anglers.



PART 2 - CHAPTER 2

THE REHABILITATION OF FISH POPULATIONS IN THE LOWER DON - DEARNE MOUTH TO GOOLE

At about the same time as the Salmon and Trout Association's efforts to restore the fishery on the upper River Don were gaining momentum in the mid 1970's evidence was also beginning to emerge of fish being present in the tidal river below Doncaster.

Water quality on this section had shown no discernable improvement since the rapid deterioration caused by the massive industrial effort of the Second World War, yet despite this, occasional fish were being found on the water intake screens at Thorpe Marsh Power Station, near Barnby Dun.



*THORPE MARSH POWER STATION
Evidence of fish reappearing in the lower River Don were found here
when fish were found trapped on the
intake screens in the 1970's*

The appearance of these fish led to some speculation amongst local anglers that a breeding population had become established. But this optimism was quickly dispelled by scientific examination of the victims. Invariably the fish showed signs of having originated from adjacent still waters and were clearly transient, being swept rapidly downstream. Many of the fish appeared during, or shortly after, a flood event and their continued existence in the polluted conditions of the Don was probably reliant on the dilution afforded by flood water.

Occasionally members of the public reported seeing small numbers of fish sheltering in the mouth of the River Ea Beck where despite the Ea Beck's generally poor water quality some amelioration of the Don's appalling conditions could be found. Rarely did these accumulations exist for more than a few days, before the fish disappeared, presumably to recommence their downstream journey.

Despite the pollution it was still receiving from coal mining activity and inadequately treated sewage discharges in its upper and middle reaches, the River Went, by the time it neared its confluence with the Don, was benefitting from a degree of natural purification. This improvement allowed some of the fish descending the Don to find sanctuary in the area immediately upstream of its confluence with the main river. Quickly an appreciable population of coarse fish established which was supplemented by small numbers of flounders and eels which had managed to ascend the short distance from the River Ouse at Goole.

By the late 1970's the existence of this population had been noted by anglers and so began the first angling activity on the lower Don system for almost half a century.

As well as the Went there was one other location on the lower river where a small number of fish could usually be found. In Doncaster the overflow channel which served to control levels between the head of the navigation and the natural river provided some sanctuary. This channel remained ponded, unless in flood conditions and as a result some limited natural purification was able to occur. During the early 1970's sightings of large fish were regularly reported and occasionally fish became trapped on the intake screens to Doncaster Power Station which took its supply from the river at that point. Surprisingly these were regularly found to be common carp, a species which was not widely distributed in South Yorkshire at that time. The origin of these fish still remains a mystery though it is likely that they, like the other early sightings, were fall out from adjacent still waters.

With the exception of a gradual improvement on the River Went, (details of which are included at the end of this chapter) conditions changed little on the lower Don over the following decade and it was not until 1985 that signs of further improvement began to emerge.



*FLOOD CHANNEL (CHESWOLD)
All that remains visible of the River Cheswold is the section which connects the navigation to the Don Flood Channel adjacent to Doncaster Prison. Doncaster Power Station took its cooling water supply from the Don at this point.*

These signs centred around the outfall from the River Ea Beck which had itself improved sufficiently for a breeding population of roach, perch and gudgeon to establish. From this source a population of these species began to develop in the main river, gradually spreading both up and downstream. Monitoring of this population's development using the techniques available to them proved extremely difficult for the Fisheries department of the Yorkshire Water Authority. Anecdotal information collected from the very small number of anglers who fished the river confirmed fish presence but attempts to carry out electro fishing surveys were thwarted by the depth, variability of flow and turbidity in the tidal conditions.

PROSPER DE MULDER - CASE STUDY

(Improvement to the effluent from this industrial site assisted in the rehabilitation of fish populations in the Don below Doncaster.)

The Prosper De Mulder factory at Bentley is a long standing Doncaster family firm. The company now operates throughout the UK with the headquarters remaining in Doncaster. The factories produce animal by-products by processing the offal produced from slaughterhouses.

The Doncaster site produces bonemeal and other animal feeds. Their processing plant requires large amounts of water which is obtained from the company's on-site borehole. The effluents are treated by the company's own biological effluent treatment plant, before being discharged to the River Don downstream of North Bridge in Doncaster.

Substantial improvements have been made to the effluent treatment plant since the 1970's. The treatment plant originally consisted of a primary treatment element only and the poorly treated effluent caused pollution of the Don downstream. Biological treatment was later added along with final settlement facilities. To improve the efficiency of the biological treatment system an anaerobic tank was added and improvements continued with the addition of tertiary settlement tanks. Finally in 1995 the company completely re-built the primary treatment part of the effluent plant. This improvement work involved substantial investment by the company and has enabled the final effluent to be further improved resulting in further benefits to the river.

By 1989 regular reports of fish rising in the river at Doncaster were being passed to Fisheries Staff and in September of that year a survey was carried out which proved to be something of a revelation. By this date more sophisticated survey equipment had become available. The river conditions in the upper tidal section around Doncaster also tended to be shallower and less turbid. The range of species and the sheer numbers of fish present was far above expectations and caused quite a stir amongst local angling interests. The survey revealed the presence of perch, pike, chub, roach, dace and gudgeon. There was also evidence that at least the latter 2 species were reproducing successfully in the river. Also surprising was the condition of the fish caught, apart from some of the larger chub which showed signs of scale erosion, their general health was good despite still far from satisfactory water quality.

Despite these encouraging signs the improvements were not being mirrored in the non tidal part of the river. Between Doncaster and the confluence with the Dearne the ponding created by the impoundments developed centuries earlier to serve the navigation, provided a much more hostile environment. The ponded river was acting as a form of secondary treatment for the vast quantity of organic effluent the river was still

receiving from upstream discharges. This created unstable ammonia and dissolved oxygen levels which frequently created conditions untenable to most fish species.

Only one location along this 7 km (4¹/₃ miles) section of the river provided some relief from these conditions. The aerating effect of the weir at Sprotbrough helped to raise the level of oxygen and to dissipate a certain amount of the ammonia content, such that it was possible for small numbers of fish to survive.

As early as 1981 fishery surveys had revealed evidence of fish presence at this point, though the species and numbers found indicated barely tolerable conditions. In a survey in 1981 only 3 three-spined sticklebacks and one small eel were caught (both of these species have a high tolerance of the effects of organic pollution). By 1984 small numbers of gudgeon had also begun to appear in survey catches and by 1987 the numbers of this species had increased considerably with the first evidence of the development of a self sustaining population. Despite these encouraging signs this population was still extremely localised with no evidence of it expanding away from the weirpool.

It was to be a further 3 years before evidence emerged of this happening. In May 1990 a member of the public reported sighting a number of fish rising in the river in the vicinity of Hexthorpe Flatts, Doncaster. The reportee was convinced that the fish were roach, and later that year his observations were confirmed when both roach and perch were captured during a survey at Sprotbrough. Though their numbers were small, examination of the fish suggested that they had been resident in the river for some time. This apparent improvement in conditions was supported by a large increase in the numbers of gudgeon present. Again confirming the establishment of a breeding population of this species.

Throughout the remainder of 1990 and into 1991 the development of fish populations in this section of the Don were carefully monitored by visual observation and by collection of catch information from the small number of anglers who were beginning to fish the river. Water quality was also carefully monitored and though the improvement was slow signs were emerging of a reduction in the mean levels of ammonia.

In the light of these improving trends a decision was taken by the Fisheries department of the National Rivers Authority to commence a series of trial restockings. Initially the fish used were obtained from netting and fish rescue operations carried out on local still waters. Because of the ponded condition of the river along this section these fish were able to adapt more readily than those from similar sources stocked into the faster flowing conditions in Sheffield. This stock, consisting mainly of roach, perch and bream vigorously spread throughout the section between the Dearne mouth and Doncaster and quickly formed the nucleus of a population which was to rapidly expand throughout the next 5 years.



*NETTING OF FISH FOR TRANSFER TO RIVER DON
A fishery management operation carried out by fisheries staff in
the early 1990's. Fish from such sources were regularly used to
develop fish populations in the Don & Dearne*

To assist in the re-establishment of former indigenous species many further restockings were carried out between 1993 and 1996 both in this section and in the upper tidal reaches below Doncaster. Most of the stock used for these operations were obtained from the Agency's fish farm at Calverton and consisted principally of chub, dace and barbel.

Benefitting from water quality improvements upstream the lower River Don had by 1996 developed into an excellent coarse fishery in both the tidal and non tidal section. A fact which is clearly demonstrated by the massive increase in angler activity which has occurred since 1993.

Exponents of the sport now travel from all parts of Yorkshire, North Derbyshire and beyond to fish the river and their success rate has been exceptional by any standard. Roach catches in excess of 20 kg (44lb) were common in the summer of 1995 and on numerous occasions the more skilled exponents could easily achieve nets of fish of double that weight.

Perhaps the most startling example of the improving condition of the lower Don was the event detailed in the following announcement.



SALMON FROM DON
The reports author shown holding an 4.1kg (11lb) salmon found dead in the Don just downstream of Doncaster on 31 December 1995. Perhaps the most vivid demonstration of the river improvement.

NRA PRESS RELEASE - 3 JANUARY 1996

SALMON FOUND IN RIVER DON

A 3' 11lb salmon found in the River Don is further proof that water quality is continuing to improve according to the National Rivers Authority.

The dead salmon was found and reported to the NRA by Mr James Ions, a local resident, on New Years Eve, one mile below Doncaster town centre.

NRA Fisheries Officers who examined the salmon found that it was freshly dead and was showing visible signs that it had recently spawned or had attempted to. These signs indicate that the fish had survived in the river for a period of three or four months.

Chris Firth, NRA Fisheries Officer for Southern Yorkshire commenting on the find said: "This is the first time in 150 years that a salmon has been seen in this condition at this time of the year. It is a very significant occurrence and it is the best indication we have had so far that water quality is greatly improving in the Don." The fish had been migrating upstream but a sluice on the river had stopped it progressing any further.

THE CANAL NETWORK BELOW DONCASTER

The enormous potential of the South Yorkshire, Stainforth and Keadby and New Junction Canals as recreational fisheries had for many years remained a source of frustration to local angling interests before their active redevelopment commenced in 1981. In the lower reaches of the New Junction and more especially the Stainforth and Keadby, natural purification had allowed fish stocks to redevelop on several occasions during the course of the 20th Century. However, the continued existence of these populations had always been tenuous, relying on the Don to supply water absent of lethal concentrations of toxins. Invariably before 1981 this had failed to be the case and several large mortalities had occurred over the years.

By 1981, water analysis results were indicating that the Stainforth and Keadby and New Junction Canals close to their confluence with the South Yorkshire Navigation, had improved sufficiently for the re-introduction of fish. In response to this, local angling interests in co-operation with Yorkshire Water Authority Fisheries staff, transferred stock from a number of local still waters to the canals. The first of these introductions taking place at Stainforth in 1981.



ANGLING ON CANALS
The canal network below Doncaster is now an important match fishery hosting the 1997 First Division National Federation of Anglers National Championships. This is a good indication of the quality of the fishery that has developed. Here the Secretary of Doncaster Angling Association weighs in a 22.5kg (50lb) catch of roach.

Initially, redevelopment was slow with little evidence of successful reproduction from the introduced stock. Steadily this began to change and by 1987 several year classes of roach were regularly appearing in angler catches.

Further introductions of stock to enhance this development were carried out over the next few years and with water quality continually improving, populations continued to expand throughout the early 1990's. By 1995, the entire canal network from Doncaster downstream had established as a quality coarse fishery providing pleasure to hundreds of anglers. The popularity of the canal network can perhaps be best demonstrated by its inclusion in the list of waters regularly used by the National Federation of Anglers as National Championship venues.

RIVER WENT

In common with many of the other rivers and streams connected to the lower River Don, the Went was seriously affected by coal mining development during the late 19th and early 20th Centuries. The effects of this industrial activity and its associated urbanisation were felt throughout the system resulting in the almost total eradication of its fish populations. The Went remained in this condition until the 1970's then, as a result of some natural purification of the effluents it was receiving upstream, it became once again capable of supporting fish in its lower reaches.

Over a period of time, small numbers of fish which had been accidentally swept into the River Don from adjacent still waters found sanctuary in the lower Went and so began the redevelopment of the river's fish population.

By 1980 this population was beginning to show signs of becoming self sustaining. Roach, bream and perch, together with eels were the predominant species and steadily, as water quality continued to improve, the populations moved further and further upstream.

Above the village of Sykehouse the Went changes its character slightly. The very ponded conditions beginning to give way to faster flowing water. These conditions favoured riverine species such as chub and dace but regrettably the stocks of these species had been eliminated from the system by pollution, preventing any chance of natural redevelopment.

To address this problem, the Fisheries department of the Yorkshire Water Authority sought and eventually found a source of chub and dace to introduce as brood stock to the Went. The fish were found in the River Ouse at Cawood concentrated around the outfall from the Bishop Dyke. The operation to net them from the Ouse was a difficult one, but one which eventually proved successful.

In 1981 more than 2,000 young chub and dace were released into the Went downstream of the A19 road bridge near Askern. The fish quickly adapted to their new environment rapidly colonising both upstream and downstream sections. From this original stock has developed a self sustaining population which has helped transform the Went from a polluted and fishless environment into an excellent coarse fishery. It is also likely that the chub and dace found later in the Don around Doncaster originated from this source.

PART 2 - CHAPTER 3

THE REHABILITATION OF FISH POPULATIONS IN THE RIVER DEARNE

UPPER DEARNE, DENBY DALE TO BROOMHILL

During the 10 years preceding 1974, some progress had been made in tackling the Dearne's appalling water quality problems. In their Annual Report for 1960, the Yorkshire Ouse River Board stated that virtually all industrial effluent was still entering the river untreated. Waste from mining, paper making, brewing and textile manufacture combining to produce a lethal cocktail of pollution which was reducing the river to an open sewer.

By 1974, as a result of pressure from the River Board and Local Authorities, many of the industrial discharges were at last receiving some partial treatment. Although chemically the river remained in Class E (poor quality) and, in places, Class F (grossly polluted) small isolated pockets of fish had begun to appear. In this respect the Dearne had a slight advantage over the River Don which still remained essentially fishless in 1974. (See Chapter 5 for definition of classifications.)

Regrettably the impetus to maintain this advantage could not be sustained and a series of serious pollution incidents throughout the remainder of that decade and well into the 1980's consistently setback any progress which was being made in the further development of the fishery.

Like the Don, the Dearne had managed to retain some remnant indigenous fish populations in isolated pockets in some of the upper reaches of its tributaries. Most important of these was the Cawthorne Beck, which flowed down from its headwaters near Denby Dale to pass through the artificially created lakes at Cannon Hall. This beck still contained a stock of brown trout, which despite intermittent agricultural pollution problems, had managed to maintain itself in the relatively undisturbed habitat in the upper reaches of its course.



*CANON HALL PARK FED BY CAWTHORNE DYKE
One of the few tributaries of the Dearne which managed to
retain its original population of brown trout*

Brown trout in the upper River Dearne itself had fared less well. Textile factories built to take advantage of the clean water in the upper part of the valley had extended upstream as far as Denby Dale, less than 2.5km (1½miles) from the river's source. The untreated effluent from this development had long since eliminated fish populations downstream of their discharges but above the uppermost mill a small hardy population had managed to cling on. Regrettably these fish had limited opportunity to contribute to the future re-development of downstream populations as the mill owners had dammed the course when building the mills to conserve as much water as possible.

In 1974, despite some efforts to improve their effluent, the textile mills were still exercising a severe deleterious impact on the upper Dearne. Highly toxic mothproofing agents used in their processes, were still entering the river making conditions untenable to fish. Resolving this issue became a priority for Pollution staff of the Water Authority but despite their efforts it was not until 1979 that the effluent was finally re-directed to sewer for treatment. This was a major step forward but regrettably, it did not completely eliminate the problem. Land contaminated by years of spillage continued to leach mothproofing agents into the river and it was almost 10 years before attempts to re-establish brown trout in the river showed any measurable success.

The first signs that fry restocking work carried out by the Yorkshire Water Authority was succeeding were found during a fishery survey carried out in July 1988. Substantial numbers of yearling trout which had been released in April 1987 were found, with particularly large concentrations centred around the village of Scissett.



ELECTRO FISHING ON THE DEARNE

Electro fishing is the most regularly used method for monitoring fish populations. The operation involves the use of an electrode which temporarily stuns the fish, allowing them to be caught and examined before being returned to the river

Despite minor mortalities originating from isolated pollution incidents this population managed to maintain its hold assisted by further fry introductions.

Six years later, the first evidence of natural reproduction in the river began to emerge. In 1994 the first naturally bred brown trout for more than a century were found in a survey conducted between Denby Dale and Clayton West. This population continued to develop over the following two years and by 1996 the upper Dearne once again had a healthy self sustaining trout stock.

Below Clayton West the Dearne's physical characteristics begin to change, the fast shallow water suitable for trout begins to give way to deeper slower pools which originally supported mixed populations of both trout and various coarse fish species. It was around this point that in 1974 the effects of the textile mill discharges began to combine with those of mining and sewage pollution. From here the river's course took it through Barnsley where other forms of industry contributed their lethal load.

As mentioned earlier, some improvements to water quality had been achieved by 1974 as a result of partial treatment of industrial effluent. Modest as this improvement was, it had allowed fish to exist in the river.

This very localised population made up of fish which had dropped out of upstream still waters such as Cannon Hall and Bretton Lakes was concentrated below the Star Paper Mill Weir in Barnsley. It relied for its continued existence on the aerating effects of the weir which helped to maintain tolerable oxygen conditions.



STAR PAPER MILL WEIR

According to reports, small numbers of fish were present at this location in 1974

In flood events many of the fish were dislodged to continue their downward journey, but their loss was relatively quickly made up by further fall outs from the upstream still waters.

Notwithstanding the fact that this was not a self sustaining population, it did act as a source of encouragement to the Pollution and Fisheries Staff of the newly formed Yorkshire Water Authority. It suggested that at least the middle section of the Dearne where it passed through Barnsley was slightly less polluted than comparable sections of the Don, despite the effects of several major sewage treatment facilities which discharged both above and below the town.

The first serious attempt at surveying the fish population of this middle section of the Dearne was undertaken in 1982. Only 2 sites were fished, at Stairfoot just below Barnsley and Broomhill near Darfield. This survey confirmed the presence of coarse fish at both locations although the population was limited, consisting only of gudgeon, minnow and the pollution tolerant 3 spined stickleback. Of most significance was the range of year classes of the former species which strongly suggested that its numbers were being maintained by natural reproduction in the river.

Further survey work in 1985 confirmed these findings and showed that the populations of both gudgeon and minnow had continued to grow. These results were further supported by the catch from a third survey site which had been added at Hoyle Mill in the centre of Barnsley. Here too, there was firm evidence of natural reproduction amongst these 2 species.

Tragically, between April 1987 and June 1988, this middle section of the Dearne was struck by a series of serious pollution incidents which resulted in the deaths of many thousands of fish. The effect of these incidents was quite clearly demonstrated in the results obtained in a fishery survey carried out in 1988. On this occasion a more extensive range of sites was fished, 8 of them on the middle section of the river. The picture which



*DEAD FISH
Roach & bream float dead on the River
Dearne near Bolton On Dearne following one
of the many fish kills caused by a pollution
incident in the early 1980's*

emerged from this work was of a chronically damaged ecosystem with few, and in some areas, no fish present. It was clear that the conditions were not simply the result of the tragic effects of the incidents which had occurred during the previous 12 months but of chronic water quality problems associated with inadequately treated sewage and minewater.

The results of the 1988 survey were made doubly disappointing to Fisheries staff by the fact that during the preceding 3 years a major restocking programme had been carried out to assist what had appeared to be a recovering fishery. More than 10,000 mixed coarse fish had been released by YWA and angling interests in an attempt to assist in this development, yet in the 1988 survey few if any of the small numbers of fish caught could be traced to this restocking work.

Over the following 3 years the middle Dearne suffered yet more acute pollution incidents which were compounded by the chronic effects of poorly treated sewage. Heavily implicated in the incidence of these conditions were the 2 sewage treatment works serving Barnsley at Darton and Lundwood.

DARTON SEWAGE TREATMENT WORKS - CASE STUDY

For many years the final effluent from Darton Sewage Treatment Works was unsatisfactory. The problem mainly was the result of a strong industrial effluent received at the works from the premises of a local carpet manufacturer. The dye residues in the carpet effluent accounted for approximately 40% of the BOD load received at the works and were difficult to treat biologically. As a consequence, the final effluent from the works always had a deep red colouration.

Until the early 1980's the problems at Darton were mitigated by the pollution that the River Dearne was receiving from upstream sources. However, when remediation of these inputs was carried out, the true effects of the discharge from Darton became apparent. The works identified itself as one of the most serious polluters of the river, certainly in the Barnsley area.

In 1985 the YWA took the difficult decision to apply to the Department of the Environment for a relaxation of the discharge consent conditions for the works. Their objective was to allow the works to comply with a less stringent consent until improvements through further investment could be achieved. Their application was turned down by the DoE.

This left the Authority with little alternative but to seek ways of meeting the existing consent which they did in the following ways:

- i) Pressure was brought to bear on the carpet manufacturers to improve their effluent before discharge to the foul sewer. This the company achieved by improving the provision of their own treatment facilities. Initially the company's objective was to produce an effluent which was of a quality suitable for release directly to the River Dearne, however this was never achieved and in 1996 their effluent was still being received at Darton works for final treatment;
- ii) An improvement scheme at the works which included an improved inlet, new storm tanks, new primary tanks and refurbished and extended tertiary treatment lagoons.

This work, which was completed in 1992, has resulted in Darton STW meeting a discharge consent of 40 mg/l of suspended solids, 30 mg/l BOD and 15 mg/l of NH_3 . The most obvious effect of the improvement scheme is the lack of any dye discolouration in the effluent.

The following table shows the performance of Darton STW between 1986-1995

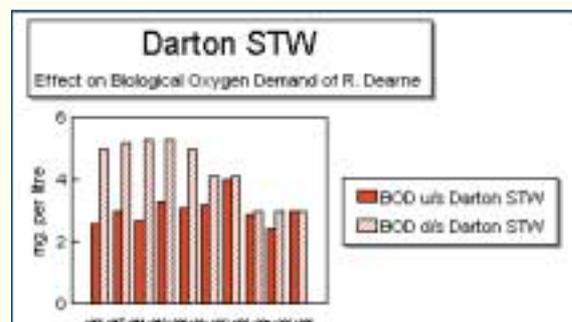
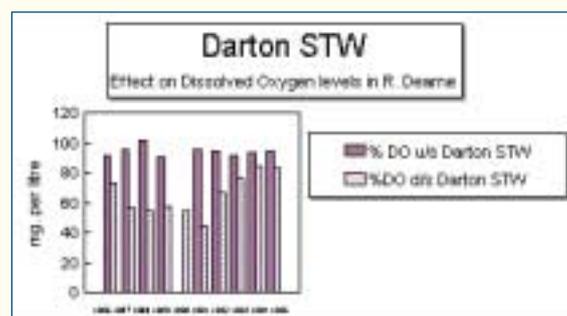
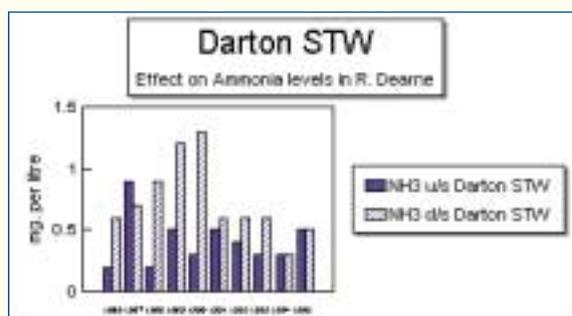
YEAR	MEAN BOD	MEAN SS	MEAN NH ₃
1986	55.8	5.9	49.7
1987	103.0	6.0	65.4
1988	83.5	9.5	59.4
1989	38.3	7.5	45.5
1990	54.4	9.5	49.0
1991	53.5	11.9	73.3
1992	16.9	5.2	23.2
1993	11.4	3.3	13.8
1994	9.5	1.9	9.9
1995	5.4	2.5	8.5

All the above analysis is in mg.1⁻¹

The following table shows the effect of Darton STW on the receiving watercourse:

YEAR	RIVER DEARNE U/S DARTON STW			RIVER DEARNE D/S DARTON STW		
	%DO	BOD	NH ₃	%DO	BOD	NH ₃
1986	92	2.6	0.2	73.5	5	0.6
1987	95.3	3	0.9	57.1	5.2	0.7
1988	101.5	2.7	0.2	54.5	5.3	0.9
1989	90.6	3.3	0.5	57.6	5.3	1.2
1990	----	3.1	0.3	54.2	5	1.3
1991	95.5	3.2	0.5	44.1	4.1	0.6
1992	94.4	4	0.4	66.6	4.1	0.6
1993	91.3	2.9	0.3	76	3	0.6
1994	93.5	2.4	0.3	84.8	3	0.3
1995	95.2	3	0.5	83.8	3	0.5

All the above values are annual means in mg.1⁻¹



The next fishery survey, carried out in 1991, confirmed that the middle section of the Dearne, through Barnsley, was suffering severe water quality problems. Few fish were found and in some cases, sites which had previously produced catches were fishless.

Surprisingly the most downstream site on this middle section of the river, at Broomhill near Wath, had markedly improved in terms of fish population. Gudgeon remained the predominant species in the catch, but on this occasion they were accompanied by several other types of coarse fish. This apparent improvement may have been the result of downstream displacement, as fish attempting to avoid the effects of Barnsley's pollution dropped down river.

The most recent survey of fish populations on the middle Dearne was carried out in September 1994. This operation at last revealed indications of a modest improvement in the general status of the fishery, although little evidence was found to suggest that it was becoming self sustaining. Major refurbishment of the sewage treatment plant at Darton was completed in late 1991 and the results of the improved effluent quality from this site were clearly demonstrated by the re-appearance of fish in significant numbers below the Star Paper Mill Weir in the centre of Barnsley, where they were first found in 1974.

In response to the improving condition of the Dearne between Darton and the centre of Barnsley (resulting from the work at Darton STW), Yorkshire Water PLC and the Environment Agency have carried out extensive restocking of this section of the river. The success of this work has yet to be fully evaluated by survey, but anecdotal information collected from anglers suggests that it has been successful and that once again a resident population exists.

Below Barnsley, however, the condition of the river has yet to show any significant signs of improvement. In terms of fish populations the situation remains unchanged from that of 1988 with no fish found in the 1994 survey at Cudworth. Clearly implicated in these unacceptable conditions is the sewage treatment works serving Barnsley at Lundwood. Here major investment is planned by Yorkshire Water PLC and work on refurbishing the works is scheduled to be completed by 1998. With these improvements in place, water quality in this section of the Dearne should markedly improve allowing the fishery to once again be re-established.



LUNDWOOD STW
The main sewage treatment works for Barnsley continues to have a serious detrimental effect on water quality. An improvement scheme which commenced in 1996 should result in a significant improvement in water quality in the Dearne downstream of the town

LUNDWOOD STW - CASE STUDY

As a result of improvements to the STW at Darton (described earlier) significant improvements have occurred in chemical river quality which has enabled the redevelopment of a coarse fish population. This population extends down to the discharge from Lundwood STW. Below this point the river deteriorates significantly as a result of poor quality effluent from the works. There are two principle reasons for this:

a) The works was not constructed to meet the needs of an increasing population and as the amount of effluent received at the works increased over the years, its effluent quality deteriorated.

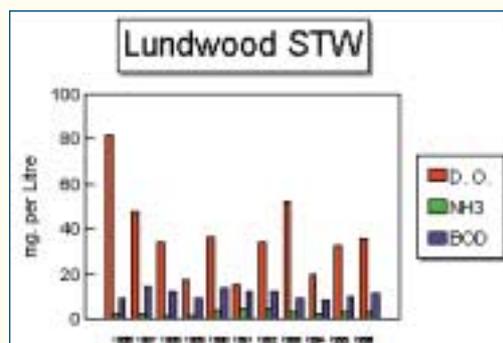
b) There has been a significant deleterious effect caused by mining activity which has affected the outfall stream from the works. The Cliffe Bridge Dyke, which acts as the conduit conveying the effluent 400m to its discharge point into the Dearne has settled as a result of subsidence, which causes ponding. This can result in the effluent becoming septic before it reaches the main river.

Below the works fish populations are almost totally absent until the river reaches Darfield. From this point natural purification allows a steady improvement to occur and various species of coarse fish begin to reappear. In January 1997 contracts were awarded by Yorkshire Water PLC for major capital works to begin at Lundwood as agreed with the Environment Agency. On completion these improvements will allow the River Dearne to achieve its water quality objectives which will allow the redevelopment of the fishery below the discharge from the works. The improvement scheme is scheduled for completion by the end of 1998.

The tables below show the unacceptable levels of ammonia, BOD and dissolved oxygen in the river below Lundwood STW.

YEAR	%DO	NH ₃	BOD
1986	81.76	2.52	8.81
1987	47.87	2.19	14.56
1988	33.9	1.2	12.25
1989	17.08	1.58	9.3
1990	36.25	3.7	13.7
1991	15.09	4.44	12.03
1992	34.34	4.47	11.78
1993	52.32	3.2	9.4
1994	19.44	2.1	8.28
1995	32.78	3.02	10.06
1996	35.36	3.14	11.21

All the above analysis is in mg.l⁻¹



LOWER DEARNE, BROOMHILL TO THE DON CONFLUENCE

The redevelopment of the fishery on the lower Dearne was initially consistent with that of the middle reaches of the river. Fluctuating general water quality combined with a series of acute pollution incidents served to frequently reduce the populations which had developed either as a result of fall out from adjacent still waters or, as in the case of gudgeon, from natural reproduction in the river.

When first surveyed in 1981 the site at Pastures Road, Denaby, approximately 1 kilometre (1/2 mile) above the confluence with the Don, produced a surprising variety of fish. Species present included pike, gudgeon, tench, roach, perch, eels and chub. Evidence suggested that the majority of the fish present owed their origin to connected still waters and the concentrations at this point indicated that their transient downstream movement had been temporarily halted as they neared the more hostile chemical conditions of the River Don.

Of some significance was the capture of one chub. This species was common in the Don system before the river's fish populations were destroyed by the effects of the industrial development of the area. Being a riverine species, its presence could not be accounted for in the same way as other coarse fish and, as far as was known, no populations had survived in the Don system. Although the origin of this fish remains a mystery, it could have been one of the first examples of illegal stock transfer to the Dearne by local anglers. (Under Section 30 of the Salmon & Freshwater Fisheries Act 1975 consent is required from the Agency to introduce fish into inland waters.)



CHUB

Between 1983 and 1988 considerable time, effort and expense was committed by the YWA Fisheries department and local angling interests to the redevelopment of fish stocks in the lower Dearne. In excess of 12,000 fish were released at points between Bolton-on-Dearne and Denaby comprising of a range of species. Included in the later introductions were 100 chub measuring between 8 and 15 centimetres (3-6in) which were the product of an experimental fish breeding unit set up by the Yorkshire Water Authority at Aldwarke, near Rotherham.

Once common in the Don, populations of this species were believed to be totally eliminated until they were reintroduced in the late 1980's

Despite considerable angler activity, little evidence of the benefits of this work emerged over the following 3 years, particularly in the higher reaches of the section. This was consistent with conditions in the middle river and was without doubt due largely to the effects of intermittent acute pollution problems.

Gradually signs of improvement began to emerge. Angler catch rates slowly increased and this evidence was confirmed by the 1991 fishery survey results which showed low levels of natural recruitment at Denaby. It was clear from this information that the fishery was not yet self sustaining but some modest improvements in water quality were being achieved which pointed to the river achieving this status if acute pollution incidents could be avoided.

Throughout the following 3 years the steady improvement was maintained and anecdotal and visual evidence emerged of a rapidly developing fishery. The small improvements in general water quality which were being achieved, coupled with a dramatic reduction in acute pollution incidents was at last beginning to show benefits.

The most recent fishery survey to be carried out on the lower River Dearne was completed in 1994. This operation confirmed the improvements in overall fish populations in the lower river and clearly identified the emergence of a self sustaining population of coarse fish. Included in the catch at Denaby were significant numbers of chub and dace, some of which clearly owed their origin to reproduction in the river.

By 1996 the lower River Dearne had become established as one of the most popular local angling venues and catches reported by exponents of the sport were clear testimony to the improvements which had been achieved.

HABITAT RESTORATION SCHEME ON THE RIVER DEARNE AT DENABY - CASE STUDY

The site chosen for improvement at Pastures Road, Denaby had been the subject of massive rechanneling work in the 1960's. This work was necessary to address the problems of subsidence which had resulted in the natural bed of the river sinking, thereby causing flooding of surrounding farmland. Regrettably, because of its chemical condition, the future ecological potential of the Dearne was not considered when the new channel was designed, resulting in a straight trapezoidal section being created. Whilst this channel was able to support a fish population as water quality improved, it provided a hostile environment to juvenile fish which could easily be swept away in flood conditions. In addition it provided little opportunity for certain species of riverine coarse fish such as dace and barbel to reproduce successfully as its ponded condition allowed large deposits of sediment to accumulate on the river bed coating any suitable areas of gravel.



PASTURES ROAD - BEFORE AND AFTER
In an attempt to recreate some of the features originally present and to provide improved spawning conditions a section of this channel was re-engineered in 1995 to create a series of bends. The full benefits of this work are unlikely to be realised for several years as they require the river's natural influences to scour and deposit bed material in a way which provides the deep pools and shallow gravel riffles so important for the maintenance of fish populations. The scheme is, however, a good example of the work which needs to be carried out on many physically degraded sections of the Don and its tributaries.

PART 2 - CHAPTER 4

THE REHABILITATION OF FISH POPULATIONS IN THE RIVER ROTHER

Of all of the rivers in the Don Catchment in 1974, the Rother was probably the most grossly polluted. The conditions were principally the result of coal mining and its associated processes and it was a sad irony that some of the worst excesses had come about as a result of man's desire to improve his environment.

The clean air campaign of the 1960's sought to reduce the levels of air pollution which frequently caused dense smogs to blanket parts of urban Britain. The problem mainly stemmed from the use of coal as a household heating fuel and in an attempt to control the nuisance, legislation was introduced to restrict its use.

To provide for the sudden massive demand for alternative smokeless fuels, coal carbonisation plants proliferated in the Rother Valley such that the valley quickly became one of the largest concentration of such industries in the world. Unfortunately the process of removing the offending chemicals resulted in an extremely toxic by product in the form of liquors rich in ammonia which proved extremely difficult to dispose of. One commonly used method was to pour the liquor on to the tops of colliery spoil heaps. This process allowed a certain amount of natural purification to occur as the liquor percolated down towards the base of the heap. Inevitably many of the spoil heaps became saturated and leachate from them slowly began to find its way into the Rother and several of its tributaries.



LEACHATE

Highly polluting leachate drained into many water courses on the Don system as a result of spoil heap effluent disposal and poor site management



RIVER HIPPER

Grayling were reported to be still present in this tributary of the Rother in the 1970's but fishery surveys failed to confirm this

This legacy of land contamination was to prove one of the most difficult problems to overcome as efforts to restore water quality and to re-establish fish populations continued over the following 20 years (see Appendix V, Case Study - Orgreave Reclamation).

In common with the Don & Dearne, the Rother's original fish populations had not entirely been eliminated by the valley's industrial development. Several small tributaries most notably the River Hipper and Barlow Brook had at least partly escaped the destruction.

Running down from their sources in the Derbyshire Peak District these two streams remained in very much their original condition in 1974. Both still contained indigenous populations of brown trout and in the case of the Hipper, anecdotal evidence suggested that the final remnants of the Don system's grayling population still existed. (This has never been confirmed in fishery surveys). There were also small numbers of coarse fish present in the Hipper, just above its confluence with the Rother in Chesterfield. Examinations carried out on samples of these fish clearly showed that they owed their origin to upstream still waters connected to the river by overflows. Never the less they did represent a potential source of stock for the Rother if water quality improvements could be achieved in the future.

One other tributary, the River Doe Lea, a stream later to become synonymous with gross pollution, was in position to assist with this form of re-development. It held a small remnant population of brown trout in its upper reaches around Stainsby and frequently coarse fish were present which had dropped out of the lakes at Hardwick Hall. Unlike the Hipper however, the Doe Lea was subjected to its own direct sources of pollution, particularly around the town of Bolsover and even today these sources continue to restrict downward movement of fish towards the main river.

Despite the grossly polluted condition of the Rother in 1985 Yorkshire Water Fisheries staff commenced a 3 yearly rolling programme of fish surveys in an attempt to confirm the absence of fish in the river. The first of the surveys surprisingly revealed the presence of a small number of 3 spined sticklebacks. Whilst this at first appeared to be an encouraging sign, enthusiasm was soon tempered by the realisation that the fish were closely confined around an input of clean water entering from a small land drain. Clearly the permanency of this population was extremely tenuous, relying for its existence on wet weather maintaining flow from the drain, a fact that was confirmed by their absence when a further survey was carried out 3 years later.

It was not until 1989 following pressure from the newly formed National Rivers Authority that determined attempts were made to address some of the most serious sources of pollution. Several major schemes were announced that year which were to herald profound improvements to water quality in the Rother.

The plants concerned, Rhone Poulenc Chemicals at Staveley, Coalite Chemicals at Bolsover and Yorkshire Water PLC's Old Whittington Sewage Treatment Plant at Chesterfield, had for many years been recognised as significant contributors to the seriously polluted state of the river and improvements to their effluent was regarded as crucial to the rivers future redevelopment as a fishery.

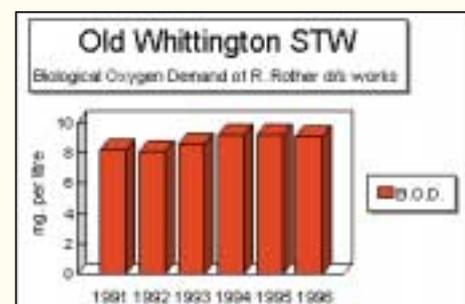
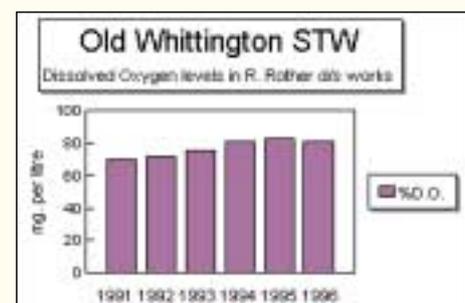
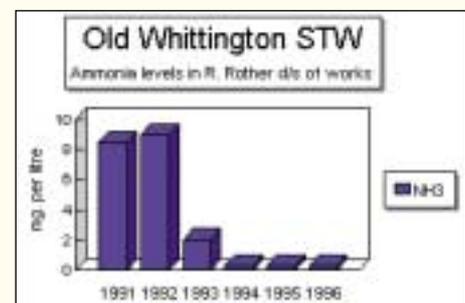
OLD WHITTINGTON STW - CASE STUDY

Old Whittington STW treats the sewage from Chesterfield. It is located to the North of the town and discharges into the River Rother. Originally built in 1926 it utilised the revolutionary Sheffield system of sewage treatment which is described in the case study on Blackburn Meadows STW. This system served for approximately 60 years. The works were extended in late 1980's and further improvement works were carried out in 1993. This latter scheme involved the transfer from the Sheffield aeration system to a modern process incorporating surface aeration, anoxic zones and nitrification. This resulted in a general improvement in downstream water quality as demonstrated in the following chart.

Partly due to the improvements at Old Whittington, the River Rother is now able to support a coarse fishery downstream of the Chesterfield conurbation the first time in almost 100 years!

YEAR	%DO	BOD	NH ₃
1991	69.9	8.2	8.5
1992	71.7	8.1	9
1993	75.1	8.6	2
1994	81	9.2	0.3
1995	82.8	9.2	0.3
1996	81.2	9.1	0.3

The above results are annual means for the River Rother at Cow lane. The limits for BOD & NH₃ are in mg.l⁻¹. The values for %D.O. are absolute.



The potential benefits of the huge investments made by the above companies was given a further boost in 1991 when it was announced that the Orgreave Coal & Coking Plant was to close. Whilst this was a blow to the employment prospects of many people, ending almost 150 years of coal related industrial activity at the site it helped eliminate yet another source of chronic pollution.

The effects of these positive developments were carefully monitored by Pollution Staff throughout the early 1990's and by the summer of 1993 it was clear that significant improvements had been achieved. Ammonia and BOD had fallen sharply and dissolved oxygen levels had risen to levels which were clearly capable of supporting fish life once again.

However, it was recognised that this was only part of the story and that despite the improving trend, the Rother was still an unstable and potentially hostile environment. For years the river had been used as a repository for every kind of offensive waste and it was necessary to educate both industry and the public about their role in protecting and sustaining the improvements. Clearly the best way of achieving this was to re-introduce fish but there were grave concerns above the ability of the river to provide food to sustain them.

To confirm that it could, a site at Rother Valley Country Park was chosen for a biological survey to be carried out. The results of this operation were not encouraging. Only 7 types of pollution tolerant invertebrate were recorded with the populations of all at a low level.

It was recognised however that this poor result was not just the effect of chemical water quality, physical habitat factors were also contributing. The channel at this point was extremely uniform having been artificially created during the restoration of land following opencast coal extraction. It had few natural features and its bed was heavily coated with deposited silts, some of dubious origin.

In an attempt to address these limitations a small physical habitat restoration scheme was designed by Fisheries Staff. The scheme involved the construction of a lump stone weir with a bay dug out of the right hand bank some 100 metres (109yds) above. (see illustrations below) The purpose of the weir was to increase flow velocities in the channel which would scour away accumulated silt and leave a clean gravel bed. In addition it assisted in maintaining dissolved oxygen levels by means of natural re-aeration. The bay on the other hand was designed to provide a sanctuary areas into which fish could escape during flood conditions or when slugs of pollution were passing down the main channel.



*WEIR & BAY ON RIVER ROTHER LOOKING DOWNSTREAM
These improvements were carried out to assist in the rehabilitation of the fishery on the river at Rother Valley Country Park*

RESULTS OF BIOLOGICAL SURVEYS CARRIED OUT AT ROTHER VALLEY COUNTRY PARK IN FEBRUARY 1994 & SEPTEMBER 1995

Taxa	(site 1 = below new weir) (site 2 = above new weir)	Abundance		
		Site 1 Feb '94	Site 1 Sept '95	Site 2 Sept '95
Roundworms	-Nematoda	0	0	1
Snails	-Hydrobiidae	2	117	756
	-Lymnaeidae	0	60	28
	-Planorbidae	0	2	0
	-Ancylidae	0	0	8
	-Sphaeriidae	1	206	27
Bivalves	-Sphaeriidae	1	206	27
Worms	-Oligochaeta	224	930	1
Leeches	-Glossiphoniidae	0	4	8
	-Erpobdellidae	0	5	19
Water Mites	-Hydracarina	1	1	5
Crustaceans	-Asellidae	185	3	1023
	-Gammaridae	0	1	145
Mayflies	-Baetidae	0	4	470
Damselfly Larvae	-Coenagruidae	0	9	0
Bugs	-Corixidae	0	5	0
Caddis Fly Larvae	-Hydropsychidae	0	0	2
	-Hydroptilidae	0	0	11
Black Fly Larvae	-Simuliidae	12	0	7
Non-biting Midge Larvae	-Chironomidae	82	424	242
Other Fly Larvae	-Empididae	0	0	2
	-Muscidae	0	0	29
BMWP Score		17	45	53
No Scoring Taxa		6	13	14
ASPT		2.83	3.46	3.78

On completion of these works a decision was made to carry out a trial restocking. As a gesture the 3 companies who had invested in improving their effluents, Yorkshire Water PLC, Rhone Poulenc and Coalite Chemicals were invited to contribute towards the cost of purchasing the fish from the National Rivers Authority's fish farm at Calverton. They agreed and at the beginning of April 1994 a consignment of fish consisting of 2,500 roach and 2,500 chub were delivered to the river. Half of the batch were released at the aforementioned site at Rother Valley and the remainder at a site at Hall Road Staveley.

Throughout the following summer visual monitoring confirmed the survival of the fish and in October 1994 a fishery survey was carried out. Recapture rates during this operation were low but the general condition of the fish was good and their growth rates confirmed that they had found an adequate food supply.



*FISH STOCKING ON THE RIVER
The first introduction to the River Rother at Rother Valley Country Park took place in April 1994. The first fish to swim in the Rother for almost a century.*

Over the winter of 1994/95 NRA Fisheries staff carried out further restocking work involving the introduction of a further 40,000 fish. Speculative angling by a number of individuals had revealed that significant numbers of fish from the original release had colonised sections well downstream from Rother Valley and this evidence was used as justification for such a large introduction. More than 85% of the fish stocked originated from routine management operations on still waters carried out by the NRA and it was recognised that the retention rates of these fish was likely to be low. However it was also recognised that fish which eventually drifted out of the Rother would assist in the development of stocks in the River Don. The other 15% of the stock introduced consisting principally of chub, dace and

barbel were flow entrained stock from Calverton Fish Farm, and it was these fish that were to form the nucleus of the developing population.

In September 1995 the river was again surveyed, this time including several new sites. The results were extremely encouraging revealing populations established at all but one location. Growth rates of fish, particularly barbel were unusually fast, providing yet another indication of the improving chemical and biological condition of the river. As if to confirm these improvements the survey also produced a number of brown trout. This species is highly intolerant of organic pollution and requires higher dissolved oxygen levels than coarse fish for its survival. The trout were believed to have originated from either the River Hipper or possibly Barlow Brook.



SURVEY RESULTS
 Fish caught from the Rother at Woodhouse Mill during a fish population survey. The fish were weighed, measured and returned to the river

Throughout 1996 work continued to establish and monitor fish populations in the Rother. In April of 1996 the first batch of chub and dace were introduced at Old Whittington, extending fish stocking upstream as far as the outskirts of Chesterfield. In addition, angling rights were leased from the Environment Agency at Renishaw and Catcliffe and organised angling recommenced for the first time in almost a century. Also appearing was the first evidence of natural

reproduction in the river with the capture in surveys of roach and gudgeon fry. This discovery gave great encouragement to Environment Agency Fisheries staff as it represented the first evidence that the River Rother was once again becoming a self sustaining fishery after more than a century of neglect, abuse and exploitation.

