PART 2 - CHAPTER 5

AN OVERVIEW OF WATER QUALITY IN THE RIVER DON CATCHMENT 1974-1996

RIVER DON AT SHEFFIELD
Pollution can be seen pouring into the river from a factory in 1974

The same location in 1996 showing part of the Five Weirs Walk.

The River Don is split into four sub catchments for river quality management. They are upper Don, lower Don, Dearne and Rother. Each sub catchment has had its own unique water quality problems in this period, but the problems of sewage treatment and sewerage are common to all of them. Increasing population has meant that new sewage works and sewers have had to be built and existing ones upgraded to treat the increasing flows to a suitable standard. This has allowed for transfer of smaller unsatisfactory works flows and the opportunity to impose stricter consent conditions and also the addition of ammonia standards. Over time with this investment and rationalisation there has been a steady decrease in pollution from sewage sources creating a reduction in levels of ammonia and biochemical oxygen demand. This has allowed the rivers to improve in chemical and biological quality.

Industrial pollution during this period principly came from steel, mining, coal carbonisation, chemical, textiles. Other pollution sources effecting water quality in the catchment are abandoned minewaters, contaminated land and agriculture.

TABLE OF CLASSIFICATION FOR BIOLOGICAL GRADING OF WATERCOURSES

Grade A - Very Good	The biology is similar/better than that expected for an average & unpolluted river of this Size/Type/Location
Grade B - Good	The biology shows minor differences from Grade A & falls a little short of that expected for an unpolluted river of this S/T/L
Grade C - Fairly Good	The biology is that expected for an unpolluted river of this S/T/L. Grade C is the target aimed for by the EA
Grade D - Fair	The biology shows big differences from that expected for an unpolluted river of this S/T/L
Grade E - Poor	The biology is restricted to animals that tolerate pollution, sensitive species will be rare or absent
Grade F - Bad	The biology is limited to a small number of very tolerant families, often only worms, midge larvae, leeches & water hoglouse. In the very worst case, there maybe no life present in the river

TABLE OF CLASSIFICATION FOR CHEMICAL GRADING OF WATERCOURSES

	DO % saturation	BOD (mg/l)	NH3 (mg/l)
Grade A - Good	80	02.5	0.25
Grade B	70	04.0	0.60
Grade C - Fair	60	06.0	1.3
Grade D	50	08.0	2.5
Grade E - Poor	20	15.0	9.0
Grade F - Bad	0	0	0

For dissolved oxygen the figure must not drop below the stated saturation for more than 10% of a 36 month period.

For biochemical oxygen demand and ammonia the figure must not rise above the stated saturation for more than 10% of a 36 month period.

FACTORS AFFECTING WATER QUALITY IN THE UPPER DON CATCHMENT

Running down from its source in the high Pennine moorland above Dunford Bridge the upper Don is mainly rural until it reaches the outskirts of Sheffield. Here the associated industries in 1974 were mainly steel manufacture and its fabrication but the most serious source of pollution were from the sewerage network of the city. In 1974 the River Don throughout this section was mostly poor quality (Class E) and grossly polluted in stretches (Class F).

SEWAGE TREATMENT (see glossary for definition)

In 1974 there were 23 sewage treatment works in this catchment, 6 of which the Yorkshire Water Authority classed as producing an unsatisfactory effluent at the time. There are presently 13 sewage treatment works, with all 6 of the unsatisfactory sewage works now gone, their flows diverted to larger and more modern treatment plants. The main sewage works in the catchment and hence the ones whose effluent quality has the greatest effect on water quality are Cheesebottom, Blackburn Meadows and Aldwarke.

Cheesebottom STW

This works, constructed in 1978, replaced 5 smaller ones serving the Penistone area. All were classed as unsatisfactory in 1974 and produced poor quality effluents. The new works has allowed the upper Don around Deepcar to improve and the trend graphs for ammonia and BOD show a decline in this period.

Blackburn Meadows STW

This is the largest sewage works in the whole of the Don catchment, serving most of Sheffield with a dry weather flow of 145,000 cubic metres per day (TCMD) (32 million gallons per day) in 1976 rising to 368 TCMD (81 million gallons per day) in 1991. Construction of a new plant at Blackburn Meadows began in 1991 and was completed in 1994 with the works then able to nitrify its effluent (ie remove toxic ammonia). This nitrified effluent has led to a huge improvement in the River Don downstream of the discharge, this can be seen in the steep decline in ammonia on the trend graphs.

Don Valley Interceptor Sewer

Construction began in 1979 and completion of Phase 5A was achieved in 1993. It consists of a new sewer at a depth of about 20 metres (22yds), this being below the level of the existing sewers whose flows it intercepts and transfers to Blackburn Meadows STW. A total of 26 inadequate overflows serving the inner and central areas of Sheffield have been abandoned as a result and there has been an approximate 50% reduction in pollution load to the River Don. The construction of the Don Valley Interceptor sewer has resulted in an improvement in water quality, by stopping the premature operation of historical storm sewage overflows in dry weather in the Sheffield area.

Aldwarke STW

Aldwarke is the primary sewage works serving the Rotherham area. Rebuilt in the late 1980's, it accommodates the flows from 4 surrounding smaller works and enables nitrification to be achieved.

INDUSTRY

Steel

The Sheffield area was and still is heavily industrialised, with the main concerns being steel manufacture and fabrication. The decline in this industry has lead to a reduction in the solids and metals load discharged to the river from various process waters, such as cooling waters and scrubbing liquors. A lot of oil is used in this industry for quenching and heating and spillages and leakages have given rise to contamination of surface water with many pollution incidents occuring during the last 30 years.

Jamont Paper Mill

This mill, formerly British Tissues, manufactures paper in the upper Don catchment at Oughtibridge. The waste produced is treated by an activated sludge (biological) treatment plant built in 1985, and has consistently produced a good quality effluent.

FACTORS AFFECTING WATER QUALITY IN THE LOWER DON CATCHMENT

In the Lower Don water quality was heavily influenced by activities in the catchments upstream and the poor quality discharges in the area will have been to some extent masked. The main water quality improvements in this period have come about due to improvements upstream in the upper river which have had a knock on effect in this catchment, eg the ability of Blackburn Meadows to nitrify its effluent has had the greatest effect on the lower Don. In 1974 the river in this area was of a poor quality (class E).

SEWAGE & SEWERAGE

There are 20 sewage works in the catchment with the major sewage works being at Sandall, Thorne and South Elmsall.

Sandall STW

This is the major sewage works in the lower Don serving most of the area of Doncaster. The works had investment in 1974 to add activated sludge to the existing filter works. On completion the works became totally activated sludge treatment, but does not nitrify.

Thorne STW

This works serves the Thorne area and in recent years Stainforth sewage has been diverted to it. The works provides only primary treatment and has a detrimental effect on water quality. Improvements to Thorne will be carried out in the near future.

South Elmsall STW

This works serves the area of Frickley, Elmsall and Hemsworth. It was upgraded in 1992 to receive Hemsworth's sewage and to improve water quality to achieve class D downstream. The works discharges to the River Eabeck.

INDUSTRY

The catchment contained extensive coal mining and with it the corresponding problems already discussed in the Dearne catchment. Other industry is mostly centred around Doncaster and is not specific in nature. Two firms which have invested in improving their effluent treatment in the last 5 years are Prosper De Mulder and John Carr's.

Prosper De Mulder are animal food manufacturers (from animal carcasses etc). The waste from their processes is highly polluting and was originally discharged with little treatment. Considerable investment was carried out by the firm on biological and physical treatment and they now consistently achieve a good nitrified effluent.

John Carr's, a joinery firm, have polluted the land they work on with wood preservatives over this period. The wood preservative contains a number of Toxic Red List substances which should not be allowed into controlled waters. They now intercept the groundwater and surface drainage through an activated carbon plant which absorbs the toxic material.

FACTORS AFFECTING WATER QUALITY IN THE DEARNE CATCHMENT

This catchment was effected by agriculture and textiles in its upper reaches before it reached the urban area around Barnsley, where the river became grossly effected by the mining industry and sewage treatment. The river is then effected by these sources all the way to its confluence with the River Don.

In 1974 the river was of poor quality (class E) and grossly polluted (class F) in places.

SEWAGE TREATMENT

The catchment had 55 sewage works discharging to it in 1974, 15 of which were classed as unsatisfactory at the time. Today there are 39 sewage works. The major sites at Darton and Lundwood serve the area of Barnsley, and Clayton West in the upper reaches serves the villages of Denby Dale, Scissett and Clayton West itself.

Darton STW

This works receives approximately 1/3 of Barnsley's sewage. It produced a poor effluent prior to it being rebuilt in 1991, causing the river downstream to be in the poorest class, class F. Since 1991, the works has produced a good quality effluent, enabling the river to improve in quality, by one class. All the trend graphs show an improvement in the river downstream at Star Paper Mill, with increases in DO and declining BOD and ammonia.

Clayton West STW

The works serves the mill towns in the upper reaches of the catchment. The works was rebuilt in the mid 1980's to treat sewage from outlying villages. There is little dilution for it's effluent and, up until its renewal, had a deleterious effect on the river. The works now produces a good quality effluent.

Lundwood STW

The major works in the catchment serving approximately 2/3 of Barnsley. The works does not produce a good effluent and causes dissolved oxygen deficiencies in the river downstream. The site has been affected by mining subsidence, reducing the efficiencies of the settlement tanks, but work is being carried to rectify this problem. Further programmed investment by YW PLC will ensure that class D can be achieved in the river downstream by 1998.

INDUSTRY

Mining

The catchment runs through a heavily mined area which made up the Barnsley coalfield. In 1974 there were 26 collieries and 57 discharges of minewater from collieries and pumping stations. Minewater is pumped from underground workings to prevent flooding and allow coal to be extracted. This water can be high in ochre/iron hydroxide due to dissolution from the pyrites (iron sulphide) associated with the coal measures. Minewaters can also have a low pH. which causes deposition of ochre on the river bed.

Ochre causes damage:-

- by reducing the diversity and quantity of biology
- reducing the extent of fish spawning grounds
- being directly toxic to fish
- rendering watercourses unfit for abstraction, recreation
- spoiling aesthetic appearance.

As can be seen from the trend graphs at the end of this chapter, the amount of iron present in the river has decreased dramatically over the years due to pit closures and minewater treatment plants being constructed in the catchment to reduce this type of pollution, ie North Gawber, Wharncliffe, Silkstone. There are other forms of pollution caused by the mining industry. Surface drainage from pit yards, coalstocking grounds etc, cause large solids loadings to the watercourse and deposition on the bed smothering plant and invertebrate life.

In 1995 there remained just one colliery in the catchment, a private mine in the upper reaches of the Dearne. Minewater is actively pumped at the old Woolley Colliery site by the Coal Authority to prevent uncontrolled minewater outbreaks. This discharge did have a detrimental effect on the river when pumping commenced in 1994, but investment in new lagoons, filters and a large reedbed/wetland has since removed ochre and significantly improved water quality.

Textiles

In 1974, 5 mills in the upper Dearne discharged to river. The main pollution problems associated with this industry were waste dyes and washing effluents. Treatment at the time included land and spoil heap irrigation, but these were not wholly successful. There are now no discharges to the river from any of these mills, they either discharge direct to foul sewer or the mills have shutdown. The Upper Dearne currently has high levels of a mothproofing agent from an unknown source, that has not been in commercial use for some years, the pollution may be due to historical practices of land treatment.

Coal Carbonisation

In 1974 there were 4 coking plants in the catchment. The spent liquor from coal carbonisation is highly polluting and all of the works would have contributed to poor water quality in the vicinity. The liquors were treated by activated sludge treatment plants and irrigation onto spoil heaps. Only one coking works is still active in the catchment at Monkton which discharges direct to foul sewer, with an overflow to watercourse in storm conditions. At Grimethorpe the liquor was irrigated over a spoil heap, although the site is now derelict there is still a discharge to the Dearne of tip leachate which is high in ammonia.

FACTORS AFFECTING WATER QUALITY IN THE ROTHER CATCHMENT

The Rother catchment, mainly an industrial area, runs through the urban areas of Rotherham and Chesterfield. In 1974 the river was grossly polluted, being class F along most of its length. The main pollution stemmed from coal carbonisation, sewage treatment and chemical manufacture.

SEWAGE TREATMENT

In 1974, 48 sewage works served the catchment, 11 of which were classed as unsatisfactory at the time. Many of the smaller works including the unsatisfactory ones have since been closed leaving the total number of STW in the catchment at 29. The main treatment facilities in 1996 are Old Whittington, Staveley, and Woodhouse Mill.

Old Whittington STW

The major works serving Chesterfield was improved in the late 1980's and in 1993 and now operates under stricter consent conditions and achieves nitrification. Apart from the Coal carbonisation industry, the works and its improvement was the biggest single factor affecting the River Rother in thisperiod. The trend graph for the river downstream at Cow Lane, shows a dramatic decline in ammonia since 1993.

Staveley STW

A new works was constructed in 1993 and operates under stricter consent conditions and achieves nitrification. The river downstream at Renishaw shows an improvement in ammonia since 1993, on the trend graphs.

Woodhouse Mill STW

This works, commissioned in 1979, replaced a number of smaller sewage works that had been producing poor effluents in the South East Sheffield area. The works was designed to enable the River Rother downstream to achieve class D.

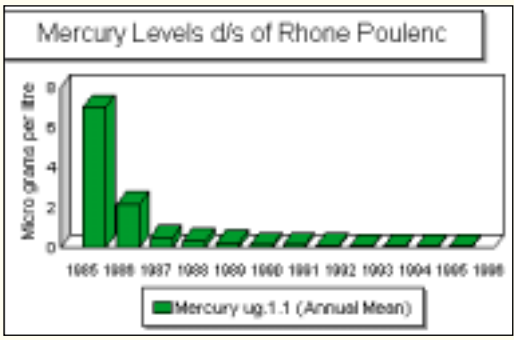
INDUSTRY

Chemicals

The chemical industry has grown alongside the coking industry. The main chemical plants being Staveley Chemicals (Rhone Poulenc), and Coalite Chemicals. The discharges from Staveley Chemicals came from the treatment plants. The polluting material tended to be mercury and ammonia. A mercury removal plant has been built and the levels of Toxic Red List substances reduced from about 23kg (51lb) per year in 1987 to virtually zero in 1995 to comply with EC Directives.

RHONE POULENC CHEMICALS - CASE STUDY

One of the major pollutants affecting water quality in the River Rother during the 1980's and early 1990's was the List 1 metal mercury. This form of pollution is highly toxic to fish and at levels of less then 1mlg/ltr can be lethal.



One of the principal sources of this contaminant was found to be the Staveley Chemicals site (now Rhone Poulenc Chemicals) at Staveley. The company operates a Chloralkali plant where they electrolyse brine to produce chlorine and sodium hydroxide. The contamination came from the process which uses a floating mercury electrode.

In the early 1980's the European Community issued two directives relating to discharges of mercury into the water environment setting limit values and quality objectives. Using the directive the EA's predecessor, the YWA made representations to Staveley Chemicals Ltd which eventually resulted in the company installing a total mercury recovery plant. This plant removes the mercury from waste water by absorbing it onto a resin and then binding it chemically into a solid form. The graph above demonstrates the effectiveness of the process by showing the reduction of mercury levels in the River Rother downstream of the Rhone Poulenc Chemicals before and after the plant was installed.

Chlorinated compounds are manufactured at Coalite Chemicals from the distillation of coking liquors. The wastes from the manufacture are dealt with in conjunction with the coking liquors at the adjacent coking works.

Coal Carbonisation

There were 4 coking plants in the catchment - Orgreave, Brookhouse, Avenue and Coalite which significantly affected water quality.

POLLUTING DISCHARGE
A typical discharge from a coking plant during the early 1980's

Until its closure in 1991, Orgreave coking works treated its coking liquors by activated sludge with discharge to the River Rother. The impact of this discharge was to significantly increase the BOD and ammonia loads to the river, in 1985 the 95%ile BOD and ammonia concentrations were 138mg/l and 146mg/l respectively. The high BOD levels were not the major problem because of adequate dilution but the ammonia levels would have had to be reduced by about 100mg/l to allow the river to achieve class D. From the trend graphs it can be seen that the River Rother downstream at Canklow has improved dramatically with respect to ammonia since the plants closure in 1991.

Avenue coking works closed in 1992. There were 2 discharges from the site, one of general works drainage and the other of lagoon effluent. Both discharges increased the BOD and ammonia loads to the river. The treatment of coking liquors at the Grassmoor lagoons consisted of aeration before discharge to Spittal/Grassmoor Brook. This discharge was highly polluting and eventually the effluent was diverted to foul sewer in 1986 to be treated at Old Whittington sewage works. There are still problems associated with the lagoons of phenolic oils leaching into the Rother.

Coalite coking works is still in operation. The liquors and general site drainage are treated together by activated sludge and discharged to the River Doe Lea a major tributary of the Rother. Investment in treatment and a gradual tightening of consent conditions i.e. in 1984 and 1989 has improved the effluent. In 1994 the works came under the control of Her Majesties Inspectorate of Pollution and new storm storage lagoons were built in 1996 to further protect the river. From the trend graphs (see end of chapter) it can be seen that there was a general decrease in BOD dowstream in the River Rother at Renishaw throughout the 1990's consistent with the improvement of effluent quality from the Coalite Plant. Brookhouse coking works was in comparison a small plant which treated its effluent by activated sludge. It discharged to Pidgeon Bridge Brook and produced an unsatisfactory effluent. It was shut in the early 1980's. The 4 coking works combined, created the most significant impact on water quality on the River Rother in this period. With their closures and improved effluent quality at Coalite, the river has now been allowed to improve along most of its length.

FACTORS COMMON TO THE CATCHMENT AS A WHOLE

Abandoned Minewaters

Abandoned minewaters are free flowing from historical mineworkings issuing from adits into surface waters. They are generally of a poor quality being acidic and high in iron. They can have an adverse effect on water quality and are also aesthetically unpleasing.

The worst cases in the Don catchment are Bullhouse and Sheephouse Wood in the upper Don and Fender on the River Rother. Although all of the catchment is affected to some extent by abandoned minewater. Many of the mine discharges were abandoned prior to nationalisation, and legally no one took responsibility for them. Throughout the period 1974-95 they have been allowed to pollute the rivers of the Don catchment.

The Environment Agency and the Coal Authority are addressing the issue of abandoned minewaters and are seeking to obtain funding for minewater remediation. The EA have produced a ranked list of discharges in order of highest environmental impact for the Coal Authority to work against.

OCHRE
The effects of the abandoned minewater discharge into the Don at Bullhouse above Penistone

Contaminated Land

It is estimated that enough waste is produced in this country to fill a void the size of Lake Windermere every nine months yet, until the 1980's simply dumping waste into a convenient hole in the ground was accepted as the best way of dealing with the problem. In the late 1980's realisation of the polluting potential of this practice, led to a move away from the dilute and disperse approach, to containment.

The dilute and disperse approach allowed the leachates produced from waste tips into the water environment. The leachates can be highly polluting with large amounts of BOD, ammonia and heavy metals, but the theory was that when mixed with surface and groundwaters they would not have any polluting effect.

Containment sites as the name implies, contain all waste and leachates by having engineered lining and leachate management systems. Environment Agency requirements to protect the water environment have become increasingly stringent, often involving multiple liners complete with leakage detection layers and pumps connected to telemetric alarms.

The Agency has strived to minimise the risk of pollution from waste disposal sites by:

- encouraging planners to favour sites where the hydrogeology affords a high degree of natural protection
- requiring conditions on Waste Management Licences
- taking direct action against polluters
- being actively involved in the formulation of guidance on best practice techniques
- implementing a tax on waste disposal to land fill following a decision by the EU

Agriculture

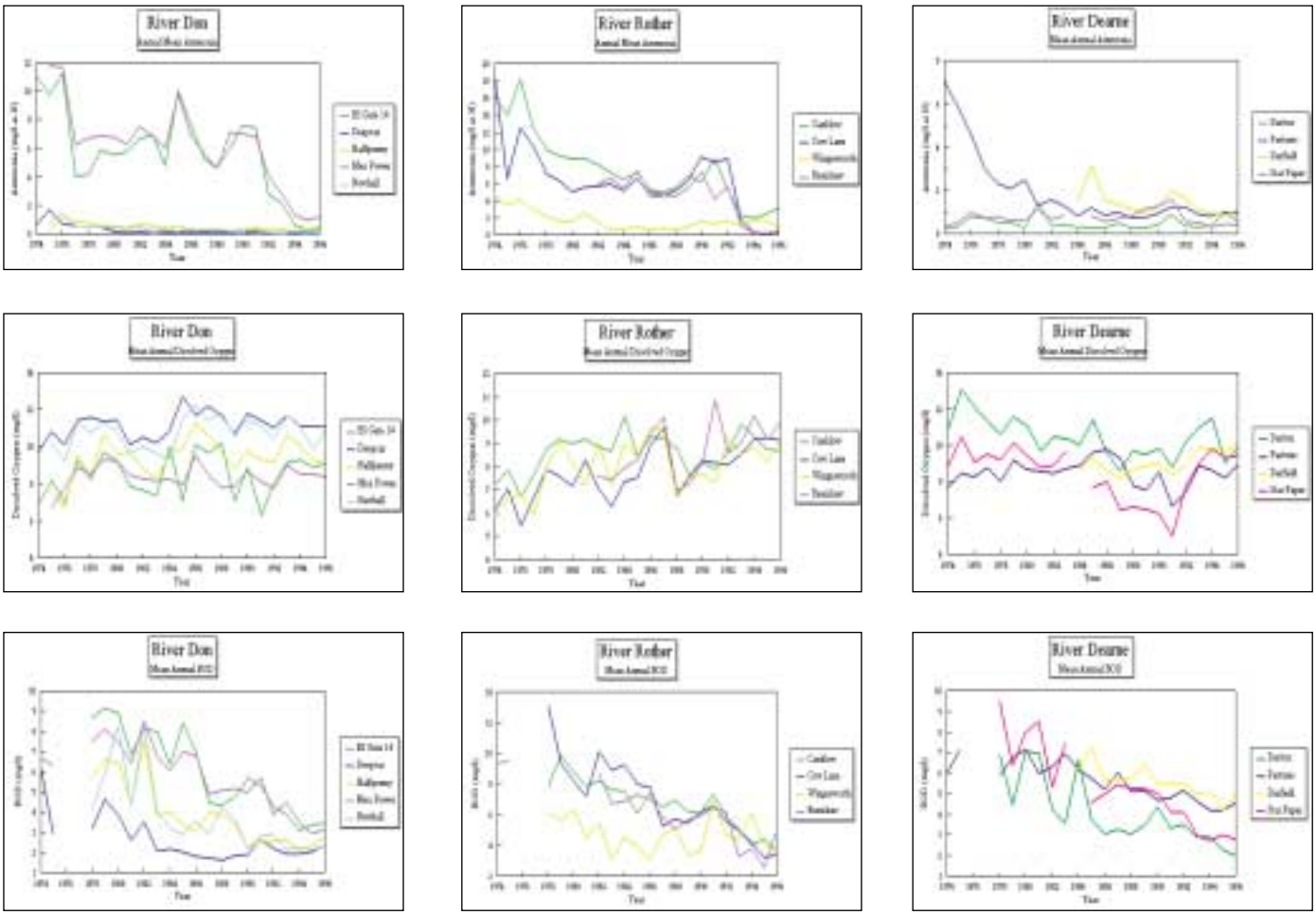
Agriculture will to some extent have affected water quality throughout the Don catchment. Pollution from farming practices has tended to be in the form of major incidents, with large polluting loads entering the watercourses for short periods due to accidents, malpractice and inadequate storage of waste.

The Code of Good Agricultural Practice (COGAP) was put together by the Ministry of Agriculture, Fisheries and Food to encourage farmers into using safe working practices to minimise the pollution of surface waters.

Further to this the 1989 Farming Regulations controlling the storage of silage, slurry and agricultural fuel oil, has given the EA an active part in the waste management on farms and has had great benefit in preventing pollution and improving a lot of farm waste storage facilities.

Summary

Overall water quality in the catchment has improved with the decline of heavy industry and improved treatment of effluent from industry and household waste. Issues and objectives for sustaining the recovery of the ecology of the river are described in Part 3.



Trend Graphs for Don, Rother, and Dearne 1974 - 96

The trend graphs indicate decline in ammonia and BOD as a result of improved water quality and the subsequent rise in the DO levels.

PART 2 - CHAPTER 6
AN OVERVIEW OF THE BIOLOGICAL STATUS OF THE RIVER DON CATCHMENT

Interest in microscopic life forms in water has been around since the invention of the microscope in the early 17th Century. However this interest has focussed on cataloguing and naming the myriad of organisms and not on investigating their ecological requirements. This trend in interest continued into the early part of this century when taxonomy probably reached its peak. The Victorian biologists were very fond of collecting and cataloguing new species.

At around the turn of the century some work had appeared in the European literature defining the 'saprobic' (pollution) status of various micro-organisms and the list of organisms thus detailed continued to grow as more studies were carried out. However in this country little interest was shown in this approach. A few early studies were conducted on specific river reaches in connection with specific pollution problems, but it was not until the late 1960's and early 1970's that the use of aquatic animals and plants to indicate water quality began to get wide scale use. Local river authorities had been set up in response to the appalling pollution problems in rivers resulting from the industrialisation of the late 19th century. In the main these had concentrated on the chemical specification of pollution. Towards the end of the 1960's most river authorities had, in their employ, a biologist but the amount and type of work carried out was minimal. The transfer of the role of the river authority duties to the new water authorities in 1974 resulted in an increase in the numbers of biologists employed by the industry and an increase in the understanding of the ability to use aquatic organisms to assess the health of the aquatic environment.

As a consequence of this there is little historical biological data on the River Don system. The fact that the river supported salmon in the past indicates that the other biological components of the aquatic system were in a healthy condition, but details of community structure remain guesswork. We can only speculate on the impacts of the changing management regimes and make assumptions about their effect on the ecology of the system.

Impoundment of the headwater parts of the catchment will have affected flow regimes which in turn will have altered the types and abundance of plant and animal communities in the system. These alterations will have been compounded by changes in water quality with the coming of industrialisation. Pollution in terms of chemical additives, changes in water temperature, fluctuating daily flows. In the lower part of the catchment the land drainage works would have had a dramatic effect on the total wetland area not just on the river itself. A once thriving wet marshland community, suddenly deprived of water would transform into dry land with a resultant loss in habitat and species richness.

Also the newly transformed river channels lack suitable habitat for plant and animal colonisation and again there is a loss of species richness. All these influences on the River Don system over the centuries has thus left the legacy of a severely impacted river system, which has needed, and still needs, very careful management to restore some form of ecological balance and rectify as far as possible the neglect and destruction carried out in the past.

RIVER DON CATCHMENT 1974 ONWARDS

The Don is regulated in it's headwaters by reservoirs and as such does not maintain a natural regime. This is reflected in the fact that the fauna at Dunford Bridge has been fairly stable for the period from 1980 onwards. There is a diverse range of animals present representing the major groups - caddisfly, stonefly, mayfly, beetle, fly and worm. However there is no overall dominance by one group but there is a consistency of occurrence. There are fluctuations in occurrence season to season and this may be linked to flow fluctuations although no analysis has been carried out to date.

Further down the river, below Penistone there were historic problems of pollution by small sewage treatment works providing inadequate treatment. This was addressed in 1977 by the building and commissioning of the

Cheesebottom Sewage Treatment Works. The small discharges upstream were stopped in 1978 as sewage was transferred to the new works. The site at Oxspring (upstream of Cheesebottom) showed early signs of immediate improvements in 1978. A single sample from 1984 and samples since 1992 have all indicated a moderate quality. Caddisfly, occasional mayfly and stonefly, midges and worms all now appear in the faunal lists for the site.

Downstream of Cheesebottom, at Soughley Bridge, slight improvements in quality began in late 1976 with the appearance of some caddisfly and freshwater shrimp. Throughout the 1980's this improved quality was consolidated with a slight increase in diversity and the establishment of sustainable numbers of individuals of all groups present. Quality has fluctuated slightly through the 1990's and the recent samples suggest further improvements seen in 1993 have not been sustained.

Downstream of the confluence with the River Little Don the quality of the river has been poor. There has been little improvement over the years with sites at Oughtibridge, Hillsborough, Hadfields Weir all dominated by worms, midges and water hoglouse, all indicative of severe pollution. Recent work on Blackburn Meadows Sewage Treatment Works and the construction of the Sheffield Trunk Sewer are expected to provide the basis of improvement of the river through and beyond Sheffield. At present these improvements are not appearing in the fauna, all samples have restricted, pollution tolerant faunas. This is probably a result of the legacy of poor quality sediment, and until there is a clean up by sediment removal under natural conditions (carried away by floods) the improvement in biological quality will be delayed.

RIVER ROTHER CATCHMENT 1974 ONWARDS

The upper reaches of the River Rother have restricted faunas indicative of poor to moderate quality. Despite closure the coking works at Wingerworth has left a legacy of tar pollution that still devastates aquatic life. The river quality can only be described as bad.

Some recovery takes place through Chesterfield. A poor (as against bad) fauna has become established since 1986/1987. However downstream of the Whittington Sewage Treatment Works the fauna returns to bad quality and has been so since early 1970's. The latest survey indicates a possible improvement to poor although this needs to be maintained in future surveys. Further downstream at Killamarsh, there have been improvements in the fauna with the appearance of mayfly, freshwater shrimp, snails and caddisfly. Even as far as Canklow mayfly and freshwater shrimp are beginning to appear in the river, albeit in low numbers.

RIVER DEARNE CATCHMENT 1974 ONWARDS

Upstream of Denby Dale the River Dearne is of good biological quality, with a diverse fauna comprising stonefly, mayfly, caddisfly, freshwater shrimp, beetles etc. A variety of discharges of effluent from mills, minewater, Combined Sewer Overflows cause a deterioration in quality below Scissett with a reduction in numbers and types of the sensitive animals and an increase in snails, leeches, worms and midges.

Sewage effluent and industrial discharges cause further deterioration in quality by the time the water reaches Haigh and flowing through Darton the river is of moderate to poor quality. At Darton the effects of saline minewaters is evidenced by the occurrence of the saline tolerant shrimp *Gammarus duebeni.*

In the lower reaches of the river there has been much engineering of the channel which has caused restriction in habitat and hence this is reflected in a paucity of faunal diversity which may not be solely related to water quality.

Recent improvements at Pastures Bridge designed to restore a range of habitats will be monitored to assess the faunal recovery.

RIVER WENT CATCHMENT 1974 ONWARDS

The River Went has only moderate to poor biological quality in the upper reaches, mainly resulting from organic pollution. The fauna comprises mainly worms, midges, leeches, snails and water hoglouse, all pollution tolerant animals. Freshwater shrimp and caddisfly do occur at times. Although heavily engineered in the lower reaches, the river has in the last few years shown an improvement in quality. The fauna still retains a pollution tolerant component but additionally mayfly, caddis, beetles and damselfly are now found.

CURRENT STATUS OF BIOLOGICAL ASSESSMENT OF RIVERS

In 1996 agreement was reached on a national biological quality classification system, the Biological General Quality Assessment (GQA) scheme. This was used to provide information on the quality of all our river systems using data collected in both 1990 and 1995 and allowed an assessment of change in quality over that five year period. The Biological GQA will be the main descriptor of biological quality used by the Environment Agency over the coming years, and will be applied to aid prioritisation of capital expenditure for discharge improvements and in assessing other improvement schemes.

Within the Don, Dearne and Rother catchments, whilst there is still a difference between biological and chemical quality assessments, there have been significant improvements in biological quality in a number of river reaches.

Wide ranging biological surveys are carried out on a five yearly basis and in the intervening years a reduced monitoring programme is undertaken to provide a baseline of data against which other survey data can be assessed. Specific problem areas can then be targeted for biological assessment. In the period from 1995 the drought has necessitated a specific programme of biological monitoring which will be ongoing for at least three years.

PART 2 - CHAPTER 7

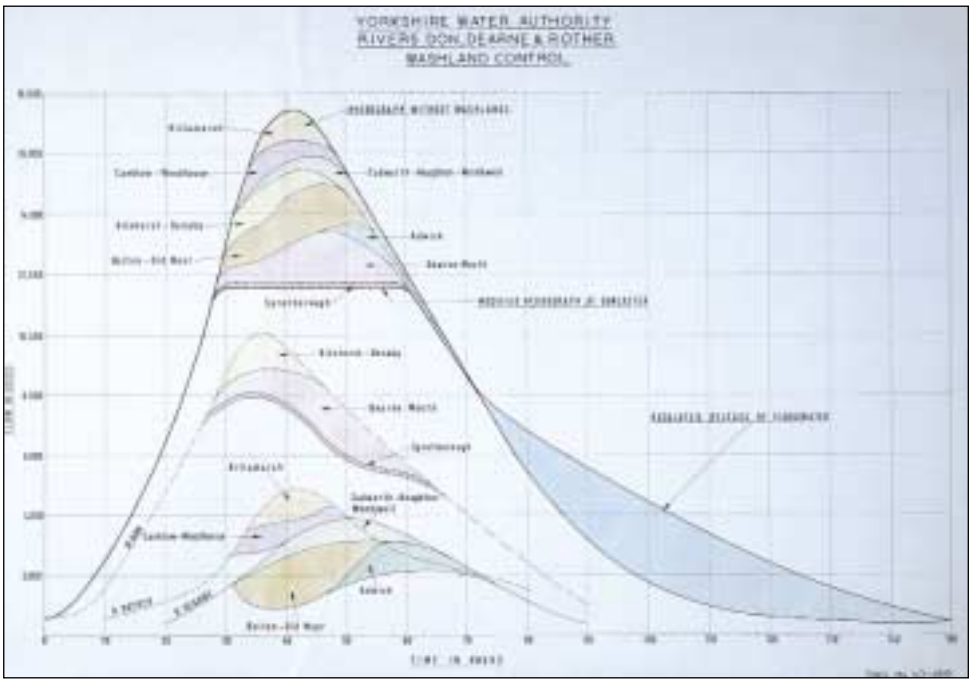
AN OVERVIEW OF LAND DRAINAGE OF THE RIVER DON CATCHMENT

In this section, it is perhaps best to start by describing the overall strategy behind the Flood Defence schemes which were carried out as flood prevention measures prior to the formation of the National Rivers Authority in 1989.

A WASHLAND AT DONCASTER
Part of the old channel of the River Don can be seen in the centre of the picture

In 1983, after a series of recorded flood events in 1958, 1965, 1970, 1977 and 1982 in the River Don catchment, a flood defence strategy was developed to improve the effectiveness of the washlands for flood control. The strategy involves the operation of six river control sluices on the River Rother and Dearne. The effect of the sluices and controlled washlands was to reduce the risk of flooding in Doncaster from an estimated 1 in 40 year flood to an estimated 1 in 150 year flood.

The hydrograph below shows the peak flood flow at Doncaster taking account of the combined flows of the Don, Dearne and Rother. Each of the coloured compartments represents the reduction in flow as a result of washland operation. Flood water is stored in the washlands until the flood subsides. The hydrograph shows that the River Don peaks after 36 hous, the Dearne after 42 hours and the Rother after 50 hours. The modified hydrograph line shows the total reduction in peak flood flow as a result of the combined washland operation.



As described in Part 1-Chapter 2, one of the early measures to relieve flooding of Doncaster from the River Don was the development of the flood relief route on the north side of the river. This was designed to reduce flood waters spreading through the town and encouraged flows through the natural floodplain along a route from Black Pond (Newton Ings) through a series of flood arches built under the Great North Road (now A638), the York Road (A19) and finally under railway embankments which carry the lines to Leeds and York.

FLOOD ARCHES DONCASTER
Flood water passing down the historical flood relief route flowed under these arches beneath the A638 Trunk Road.

If the river channel capacity at Doncaster is in the future exceeded, then the historical flood relief route should still help reduce the spread of flood water through Doncaster. However the development which has occurred in its path since the route last operated in 1947 will undoubtably suffer from flooding. At present there are over 500 houses/shops, 40 industrial premises and 130 residential caravans at risk.

Lower Don

Since the early 1980s relatively little flood defence work has been carried out on the lower Don. Of the small number of protection works undertaken, perhaps the most important has been the raising of the tidal defences at Goole. The floodbanks here were raised based on a recorded tide level of 5.8 metres ($6^1/_3$yds) AOD at Goole in 1983. The defences have been raised with a freeboard taking account of a predicted rise due to global warming and tectonic changes for an estimated 40 years period.

Other works on the lower Don have involved the reconstruction of the flood gate at the River Went outfall in 1985, which improved the protection of the Went catchment against the high levels encountered in the Don as a result of tidal and flood conditions.

In 1990, a scheme commenced on Ea Beck to improve floodbanks which had suffered from subsidence and erosion. This comprehensive scheme which was still ongoing in 1996 will improve the flood defence upstream as far as the village of Skellow.

Upper Don

From the mid 1980s onward most of the flood protection works carried out on the upper Don catchment have been concentrated on tributaries such as the River Sheaf.

RIVER SHEAF FLOOD ALLEVIATION SCHEME - CASE STUDY

The River Sheaf and its tributary, Porter Brook, rise in rural moorland south of Sheffield, but their lower reaches run through densely built-up urban areas. The River Sheaf drains an area of 68 square kilometres (16803 acres) to the south west of Sheffield and flows into the River Don in the city centre. The upper part of the catchment is mainly rural. The lower part of the catchment is suburban becoming increasingly urban as it passes towards the city centre. At Granville Square, the river enters a complex underground system of culverts which allows water to pass beneath the Midland Station, the Ponds Forge sports centre and the Sheaf Market before joining the River Don downstream of Lady's Bridge.

Flooding on the Sheaf generally occurred at a threshold of approximately 1 in 7 years with recent major floods having occurred in 1958, 1973, 1982, and 1991. Approximately 20 hectares ($49^1/_2$ acres) of land, comprising mainly of industrial, commercial and retail property, and at least 80 houses are at risk. The flooding occurred when flood water escaped from the channel onto the road system towards the city centre. The industrial history of the area left a legacy of culverts, weirs, low services, poor defences and low bridges along the river, which caused restrictions in the channel. The river also suffers from severe debris accumulation, which comprises mainly of dead vegetation, litter and illegally dumped items, this was recognised as a major cause of flow restriction.

The comprehensive Flood Alleviation Scheme commenced in 1991, and consisted of 4 phases from the River Don confluence to Archer Road, which were completed in February 1997. The cost of the works was £3.6 million. The phases involved the following works;

- Constructing a mechanised screen at Granville Square to keep the culverts free of debris
- Streamlining culvert transitions to improve self cleansing.

- Cleaning and regrading the river bed - Lowering weirs
- Building retaining walls - Raising bridges and pipes
- Improving access to make maintenance easier

The scheme generally protects property from flooding for up to a 1 in 50 year flood. During the works a flood occurred in 1991 caused by a complete blockage of the debris screen at Granville Square, resulting in flooding at Granville Square and the Midland Station. The debris screen was later modified with an innovative design which increased the screen area whilst incorporating an overflow facility, without any channel enlargement.

The biological water quality of the River Sheaf is generally good for an urban watercourse, though deterioration has been noted around the discharge points of storm sewer overflows. In habitat terms the river has considerable interest, the majority of the channel exhibits good flow characteristics and in-stream features such as riffles, runs and pools. As part of the scheme some fish passes and pools were installed to maintain and improve the fishery which presently consists of stoneloach and minnow with brown trout present above Archer Road.

River Rother

The River Rother and its tributaries have had a number of flood alleviation schemes carried out on their reaches since 1974. Most of these works formed part of the comprehensive River Rother Improvement Scheme.

As development increased in the catchment, flood alleviation was an issue to be considered. The Rother Valley Country Park was formed after opencast mining operations were completed in 1981. As a condition of this scheme going ahead the Yorkshire Water Authority required that the existing flood storage volume of the Bedgreave washland was to be maintained, and also the drainage problem at Killamarsh was not to be made worse. To take account of increased surface water run-off from the extensive Mosborough Development Area an additional storage of 200,000 cubic metres (44 million gallons) of flood storage was also to be provided. The country park was completed in 1985 and now serves an important function in the strategy for flood alleviation downstream as well as providing a popular leisure amenity. A fish-belly bottom hinged regulator known as Meadowgate Regulator, with an unobtrusive appearance was installed in 1979 to provide the flood storage requirement from the three washland compartments upstream. The recreation lake, being one of the compartments, would be the last in a very severe flood event to be filled for flood storage from the River Rother. The recreation lake is used for various human water activities, and because of the poor quality of the River Rother, is filled with water from the River Moss abstracted at a weir upstream of Eckington.

In the 1980's improvement schemes were carried out upstream of the Rother Valley Country Park on the River Rother and its tributary, the River Whitting. At Slitting Mill, near Renishaw a scheme was carried out on the Rother to formalise a controlled washland and reduce the frequency of flooding to the Staveley to Eckington Road (B6053) and nearby farms. In Staveley a scheme was carried out to improve the channel capacity where it was restricted. Further upstream in Chesterfield improvements for the protection of properties from Rothervale Road to Sherwood Street, off the Derby Road, were carried out where 48 houses and 3 small industrial premises were inundated during the 1982 flood event.

In the mid 1980's a flood alleviation scheme was carried out on the River Whitting in Chesterfield, a tributary of the River Rother, to protect property particularly at Whittington Hill against flooding. The scheme extended from the confluence with the River Rother to the Sheffield Road Bridge (A61). In this scheme flood levels were reduced by regrading and re-sectioning the channel, obstructions were also removed and floodbanks constructed.

Road improvements in the catchment have also had their effect on the Rother. One example carried out in the late 1980's was a channel diversion to allow for the construction of a roundabout for the Tapton Bypass. This resulted in a section of the natural course being re-routed, reducing the channel length.

River Dearne

From the early 1980's onward most of the flood defence work carried out on the Dearne system has been related to channel maintenance, particularly those sections which had been straightened and widened by earlier works. In low flows the river deposits considerable sediment loads in these sections as the velocities begin to reduce, leading to reductions in channel capacity. The problem of siltation has particularly affected some of the downstream reaches of the river between Adwick and Denaby. Recent channel improvements between Pastures Road and Mill Lane to improve the fishery habitat with a narrower sinuousoidal channel has resulted in a faster flow helping reduce silt deposition and producing some self cleansing benefits.

Wath Upon Dearne was an area which had suffered from dereliction after coal mining had ceased. As a result of reclamation works, a large scale development area has been formed , known as the Wath Manvers Regeneration area. The area included the development of the controlled washland at Old Moor from which some of the fill material used for the large scale earthworks at Manvers had been obtained. In 1996 , a wetland and wildlife reserve was created from the voids and the function of the reserve as a controlled flood storage area was maintained in the design.

Flood Control & Nature Conservation

After a history of engineering solutions to resolve flooding problems from rivers, there are sites where flood control works have been carried out which are now Sites of Special Scientific Interest (SSSI) such as Denaby Ings Nature Reserve and Sprotborough Flash. These areas are protected for their ecological value, but still serve a function for flood control. As the main operating authority, the Agency's Flood Defence department has initiated a consultation process with interested organisations such as English Nature and RSPB, with the aim of producing a Water Level Management Plan. These plans will ensure that maintenance and operational activities do not detrimentally affect water levels in important wetland areas.

PART 2 - CHAPTER 8

AN OVERVIEW OF WATER MANAGEMENT OF THE RIVER DON CATCHMENT

ABSTRACTIONS

The water power available from the fast flowing Pennine streams was one of the attractions for the development of heavy industry in the catchment in the 19th Century. The rivers also provided water for cooling purposes, which was essential for the steel and engineering industries.

Public water supplies had been developed in the Pennines to serve the needs of a growing demand as early as 1836 (see details of reservoirs in Part 1, Chapter 1a) but by 1937 even these reservoirs were becoming inadequate. To address this problem water began to be imported into Sheffield from the Derbyshire Derwent reservoirs. This supply is still fed via a pipeline into the reservoirs at Rivelin.

Lower down the valley, the Sherwood Sandstone around Doncaster is a major aquifer which since the early part of this century has supplied most of the drinking water needs of the area. Most of the supply sources are within the Trent catchment towards the south east of the town with two of the larger boreholes at Sandy Lane and Nutwell. The magnesium limestone which underlies the sandstone is also a source of water.

In 1964 water for public supply began to be imported into the Don catchment from the Elvington abstraction on the Yorkshire Derwent (see Appendix II, Case Study - Drinking Water Supply). This addressed the problem of a rapidly developing supply deficit and since, most of the increased demand in South Yorkshire has been met from this source.

Most of the reservoirs in the catchment were developed following the promotion of local Acts of Parliament. These acts specified amounts of water to be released to the rivers to compensate water power users further downstream for the effects of the impoundments. These were mainly water powered operations. This latter use has now diminished but the release of "compensation water" is very important to maintain low flows for the protection of fisheries and wildlife and also serves to ensure supply to several more modern industrial users.

The most recent reservoir development was Winscar at the head of the Don Valley. This reservoir came about as a result of the enlargement of an existing facility at Dunford Bridge and water from this source entered supply in 1975.

The Water Resources Act 1963 brought in a widespread system of abstraction licencing. Existing abstractors from surface and underground waters, including the public supply reservoirs were given a "licence of right" with conditions on the volume of water that they are entitled to take based on use at the time or the rates specified in the Acts of Parliament. Many of these licences are still in use today.

Industry, farmers or water companies wishing to develop new abstractions or change existing ones are required to obtain an abstraction licence from the Environment Agency. The terms under which a licence is granted, (which includes any conditions attached to it) must prevent any derogation from the rights of existing lawful abstractors and is designed to minimise impacts on the Environment.

The table opposite shows the amount of surface water abstracted from the Don catchment in 1974. When compared with the table showing comparable figures for 1996 it can be seen that there has been a considerable reduction in the use for cooling by power stations and industry. This results from the closure of several small inland power stations eg. Neepsend, Blackburn Meadows, Mexborough, Doncaster and Thorpe Marsh and steel works in the Rotherham and Sheffield areas.

Conversely there has been a rise in the amount abstracted for spray irrigation by farmers. This is a relatively small proportion of the total water use on the Don System but it can have a significant impact on smaller tributaries particularly the River Went. Since 1986 all licences for consumptive use have been issued subject to a time limit and a condition which requires abstraction to cease at times of low river flow.

SURFACE WATER

	1974 (NoL)	TCMA		1996 TCMA	(NoL)
Water Undertaking	(38)	104,467,360	increase to	125,790,200	(13)
Industrial	(185)	662,631,800	decrease to	30,653,110	(59)
Agriculture	(53)	81,820	decrease to	74,950	(51)
Other	(25)	22,400,000	decrease to	19,604,691	(65)

(TCMA - Thousand cubic metres per annum)
(NoL-Number of licences)

There has been a similar if not more dramatic reduction in ground water use by industry. This has largely resulted from the decline in the mining industry of South Yorkshire. To maintain the workings in a dry condition it was necessary to pump out water from the bottom of pit shafts. Some of this water was used on the surface for coal washing plants etc. but the majority was discharged following settlement treatment to adjacent streams.

The cessation of controlled pumping at disused colliery sites has resulted in a significant recharge of groundwater reserves. As water levels rise the possibility of this resulting in the emergence of uncontrolled discharges of highly polluting minewater increase. The EA document Environmental Assessment of Selected Abandoned Minewaters in the North East Region has recently been published and gives details of the problems associated with this phenomena. The following table gives the quantities of ground water abstracted from the catchment to serve the needs of water undertakings (drinking water supply), agriculture (mainly spray irrigation), industry (mainly mining) and other,(bottling plants, private drinking water supply).

GROUND WATER

	1974 (NoL)	TCMA		1996 TCMA	(NoL)
Water Undertakings	(17)	7,968,181	decrease to	218,784	(6)
Industrial	(168)	595,063,060	decrease to	7,283,637	(39)
Agriculture	(67)	495,409	decrease to	201,303	(81)
Other	(11)	86,096	increase to	1,718,576	(39)

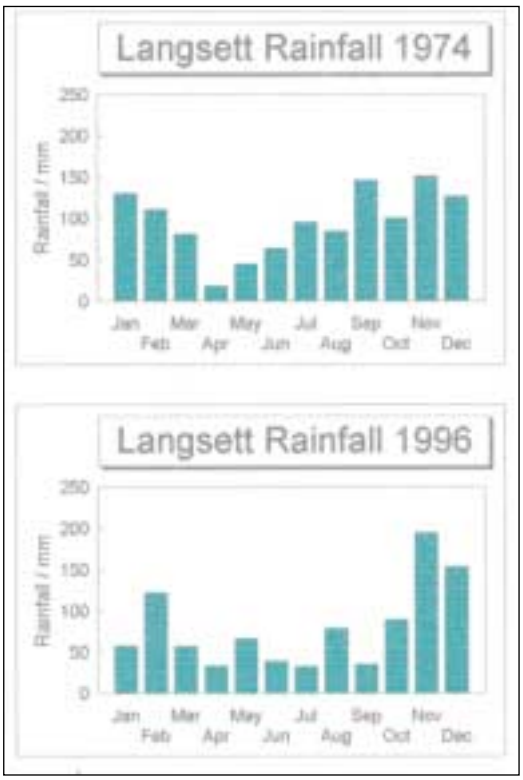
(TCMA - Thousand cubic metres per annum)
(NoL-Number of licences)

Most of the surface water sources in the Don catchment have been fully exploited hence the need to import water from the River Derwent at Elvington. It should be recognised that much of this water, after being used for household and other purposes, is treated and then discharged to rivers and streams in parts of the Don catchment. This net import of water is significant and contributes greatly to the flow of the Don during dry weather conditions. It is estimated that the discharge from Blackburn Meadows STW in Sheffield constitutes more than 50% of the daily flow of the river during a period of low rainfall.

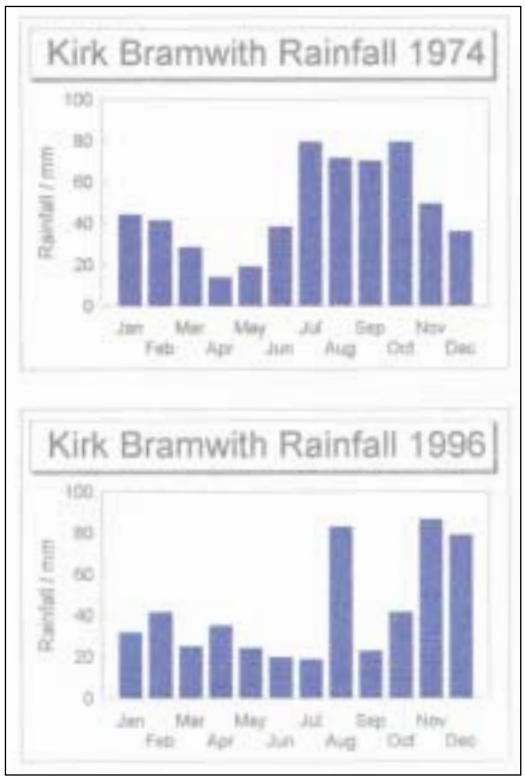
RAINFALL GUAGING

Graphs 1 and 2 show the variability of rainfall levels throughout the 22 year period between 1974 and 1996. Graph 1 is for the guage at Langsett in the upper catchment and Graph 2 is for the guage at Kirk Bramwith in the lower tidal area of the catchment. Graphs 3 and 4 show the rainfall levels for the 12 month period Jan-Dec during 1974 and 1996 (a drought year) at Langsett and Kirk Bramwith. Graphs 5 and 6 show the daily flow at Hadfields Weir at Sheffield during 1974 and 1996. These are compared with the long term minimal flow.

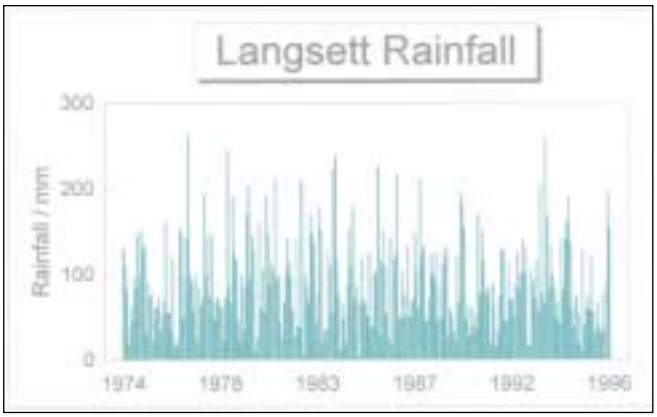
1.


Langsett Rainfall 1974
Rainfall / mm
250
200
150
100
50
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Langsett Rainfall 1996
Rainfall / mm
250
200
150
100
50
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

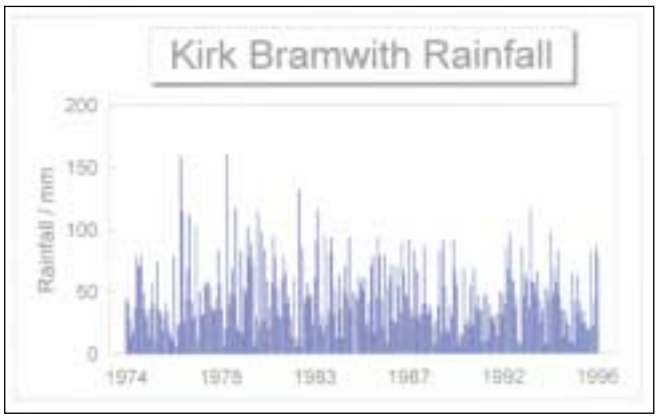
2.


Kirk Bramwith Rainfall 1974
Rainfall / mm
100
80
60
40
20
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Kirk Bramwith Rainfall 1996
Rainfall / mm
100
80
60
40
20
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

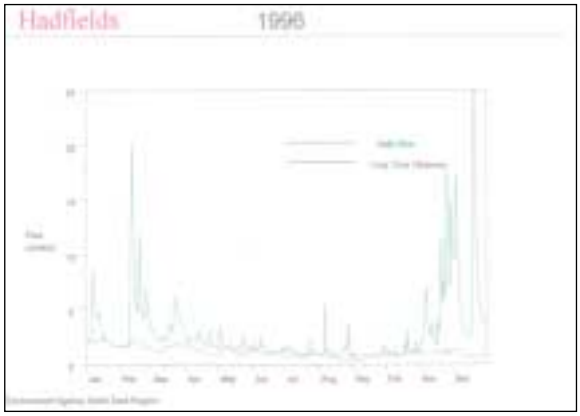
3.


Langsett Rainfall
Rainfall / mm
300
200
100
0
1974 1978 1983 1987 1992 1996

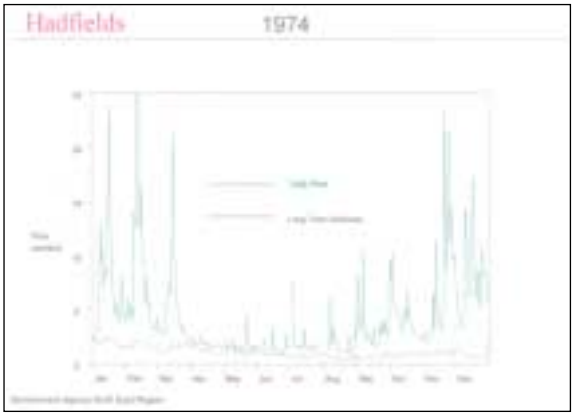
4.


Kirk Bramwith Rainfall
Rainfall / mm
200
150
100
50
0
1974 1978 1983 1987 1992 1996

5.


Hadfields
1996

6.


Hadfields
1974

PART 2 - CHAPTER 9

AN OVERVIEW OF THE CONSERVATION STATUS OF THE RIVER DON CATCHMENT

KINGFISHER
Now a common site along the banks of the River Don

Throughout most of this century the Don Catchment has, to a large extent been ignored as a conservation resource. The loss of wetland habitats and the decline of the river itself led to many people writing off the whole catchment with the exception of a few isolated sites, which had managed to survive or which had been inadvertently created by mans activities. Since the mid 1970's there has been an increasing effort to assess the current conservation status of the catchment and also to identify the potential for improvements to be carried out. At the same time, public awareness of environmental issues has grown immensely. Surveys of land use, the identification of sites of existing conservation value and increasing sensitivity in the way in which flood defence work has been carried out, have all led to improvements in the catchment. The recent dramatic improvements in water quality have allowed some significant changes in the status of both individual species and habitats in general. For example, the sighting of kingfishers in the centre of Sheffield has become commonplace.

HIMALAYAN BALSAM
One of the alien weeds which has colonised parts of the Don system

In common with many of the river catchments in England, the Don has seen very extensive colonisation by alien weeds such as Japanese Knotweed and Himalayan Balsam. The river in places has been noted for the presence of other aliens such as the famous fig trees. These Mediterranean trees have grown at a number of locations in Sheffield over the past 60-70 years. There are in excess of 30 specimens recorded, usually growing at the base of retaining walls at the river's edge. The seeds of figs are thought to derive from sewage. Experiments on the silt downstream of sewage works found that seeds could be germinated from figs, tomatoes, strawberries and citrus fruits. Germination of these exotics is thought to depend on warm water inputs which were formally very common from industrial sites throughout Sheffield. Records are available which show that the river ran at a constant 20°C (68°F) all year round and would exceed this temperature during times of peak production in the local steel industry.

Lower down the system the loss of natural wetland areas adjacent to the river channels as a result of land drainage work has, to some extent been compensated for over the last century by the formation of open water areas which were a result primarily of mining subsidence. A number of these sites, most notably the flashes at Denaby, Sprotborough and Broomhill are of regional and in some cases, national importance for nature conservation. At Wath Ings, drainage work in the 19th Century led to formally wet areas used for grazing and hay cropping being made available for more intensive agriculture. However, mining subsidence in the 1960's and early 1970's reversed this trend so that open water re-appeared on the site. In recent years the open water area became sufficiently large that it was attractive to migrating birds on their spring and autumn journeys. Birds such as snipe, redshank, golden plover and dunlin are common on these subsidence areas, whilst from time to time rare species such as osprey, marsh harrier and avocet have been known to visit.

In winter the sites are used by large numbers of wildfowl. The Wath Ings site is part of a complex of complimentary habitats located around the River Dearne and including Broomhill Ings and Flash, Gypsy Marsh and Wombwell Ings. At Denaby Ings also adjacent to the Dearne, the Yorkshire Wildlife Trust manage another important area of open water and associated habitats. More than 300 species of plant have been recorded from this site as well as nearly 170 species of bird. Insects are also an important part of the conservation value of this reserve. Alongside the River Don at Sprotborough lies another of the Yorkshire Wildlife Trust's sites. Sprotborough Flash was formed by subsidence around 1924. It runs parallel with the river for a distance of

almost 1.2km (3/4 mile), connected only by an overspill pipe at it's eastern end. Like Denaby Ings, the Flash is important for its bird, plant and insect life and incorporates within its boundary part of the magnificent wooded limestone heights of the Don Gorge. Here despite quarrying and latterly land filling, there still remain substantial areas of the ancient woodland which once covered most of the Don Valley. Ash and Wych Elm are present with a very diverse shrub layer. Invertebrates are also an important element in the conservation interest of this area. In early 1997 the EA carried out works at Sprotborough which will enable the water levels in the reserve to be more sensitively managed.

SPROTBOROUGH FLASH
One of the areas of subsidence adjacent to the river which has developed as an important wildlife site

On the tidal section of the River Don the large scale drainage of the catchment had the effect of modifying the tidal regime of the river, allowing much of the former flood plain to be developed for agriculture and increasingly isolating the river from the surrounding land. In the early years many of these species rich areas, particularly those sites of unimproved grassland were managed as hay meadows. Today, few of the hay meadows survive, but examples such as Went Ings Meadows near Stainforth show what much of the area would have been like. Grass species such as Yorkshire fog, sweet vernal grass and tufted hair grass are present in a sward which commonly included great burnet, common knapweed, ribwort plantain, yellow rattle as well as relatively uncommon species such as adders tongue, dyers greenweed and pepper saxifrage. Regrettably modern grassland management throughout the rest of the Don catchment has removed the vast majority of these species rich meadows. The examples described above represent only a small proportion of the sites of conservation value in the catchment. Many others exist which in their own right are equally important. Some sites such as the Yorkshire Wildlife Trust washland reserve at Woodhouse Mill on the River Rother require extensive remediation to fulfill their true potential. Here the Trust is working in close co-operation with the Environment Agency to raise the capital investment required to carry out works which will, with the hard work and commitment of the Trusts volunteers, eventually return this section of the Rother Valley to something like its pre-industrial condition.

THORNE MOORS NATIONAL NATURE RESERVE

The Thorne, Goole and Crowle Moors, together form the largest remaining area of lowland peatland in England. They are a grade 1 SSSI covering 1918 hectares (4740 acres). The moors complex which exists today is all that remains after various attempts at drainage and land reclamation. The work which was carried out by the Dutch land drainage engineer, Cornelius Vermuyden in the early 17th Century was not entirely successful and resulted in flooding of previously drier land. A further process of improving land for agriculture was started in the early 19th Century and this was commonly known as warping. It involved the construction of warping drains connected to the tidal rivers. At each tide, water from the drains was allowed to flood into embanked areas to deposit nutrient rich silt on the land surface. The process was very successful and the fertility of large areas of acidic peat was improved so that large areas of marshland were converted to good agricultural land.

The inner part of Thorne Moor was not improved in this way and remains a peatland. For hundreds of years local people removed peat from the area for various purposes including cattle litter and for use as fuel. Later these removal operations became commercialized, eventually under the control of Fisons PLC. The national nature reserve was purchased from the company in 1995.

The site supports a range of specialist plants including bog rosemary and sundew, a plant which relies on trapping insects on its sticky leaves to obtain additional nutrients. More than 2,800 invertebrate species have been recorded from the reserve and it is a stronghold of the nationally rare large heath butterfly. The vast area of moorland also provides an important wintering refuge for birds including the hen harrier, hobby and short eared owl. Resident populations of the nightingale and nightjar are also present. Access to the reserve is by permit only from the Warden, English Nature, Bull Ring House, Northgate, Wakefield, West Yorkshire, WF1 3BJ.

CONSERVATION AREAS & SITES OF SPECIAL SCIENTIFIC INTEREST (SSSI'S) WITHIN THE DON CATCHMENT

Name	Description	Designation
Went Ings Meadows	Spring fed hay meadow	Flora
Sprotborough Gorge	Ancient Woodland	Trees
Denaby Ings	Open water	Birds, Flora
Little Don Stream	Watercourse	Geological
The Dark Peak	Moorland/Wetland	Birds, Flora, Fauna
Moss Valley	Watercourse & associated land	Plants, invertebrates
Moss Valley Meadows	Woodland	Plants, trees
Doe Lea Stream	Watercourse	Geological
Carr Vale Flash	Open Water	Plants, birds
Catcliffe Flash Nature Reserve	Wet grassland & open water	Plants, birds
Blackburn Meadows Nature Reserve	Reclaimed slag heap	Invertebrates, Fauna

PART 2 - CHAPTER 10
AN OVERVIEW OF THE RECREATIONAL USE OF THE RIVER DON CATCHMENT

Watercourses have always been attractive to man, initially because they were a source of food and a means of transport. Over the centuries rivers developed into a recreational amenity with water based activities such as fishing, boating, swimming and river bank walking.

As the valleys of the Don, Dearne and Rother became increasingly industrialised, so their potential as a source of recreation began to diminish.

Anglers were left to mourn the loss of what had previously been a fine fishery as deteriorating water quality reduced and finally eliminated fish populations. Pursuits such as swimming and boating also lost their attraction as the once clear waters were reduced to a smelly cocktail of pollution.

In the major towns, the development of industry up to the waters edge hemmed in the river, hiding it from view and eliminating the traditional footpaths along which generations of the valleys inhabitants had strolled. The destruction of flora and fauna also led those with an interest in the natural world to seek other areas to pursue their recreation.

Undoubtably there were those who rallied to try to reverse these trends but their protestations generally fell on deaf ears. One such attempt prompted the Sheffield City Council on the 9 November 1908 to prepare plans for a section of the river near the city centre to be widened and deepened to provide for public boating. However, after due consideration the plans were abandoned primarily on the grounds of engineering difficulties but there were undoubtably fears concerning the risks to public health.

The loss of the rivers as a recreational resource also had financial implications for many of the former recreators. Angling was and still is, a pastime enjoyed by many. Miners, steelworkers and others working in the filthy, smelly and noisy heavy industries of the Don Catchment enjoyed the sport as a means of escape from the drudgery of their everyday working lives. As fish populations disappeared from the rivers, anglers were forced to seek alternative waters, such as ponds and lakes to pursue their hobby and many had to travel many miles to reach such facilities.

By the 1940's, the relative prosperity of these workers had improved such that they were able to look ever further afield for suitable fisheries. The large angling associations which had developed in Sheffield and the other large towns began to acquire their own waters in places as distant as the Fenlands of East Anglia. Each weekend, a mass exodus of anglers occurred numbering many thousands of men. Special trains were made available by the railway company and large numbers of motor coaches took organised parties to fish at locations as far afield as the Great Ouse Relief Channel in Norfolk and the Dales rivers of North Yorkshire.

By the late 1980's the effects of water quality improvements on the water environment began to encourage the return of recreational activities on the Don system. Returning fish populations attracted the attention of a new generation of anglers who increasingly began to turn their attention to the river. The steady return of birds and wildlife and the emergence of marginal plant life encouraged people once again to experience the pleasure of a walk along the river bank. Use of the navigation by pleasure craft also began to increase as the general ambiance of the Don Valley improved.

Following is a brief description of some of the recreational activities and opportunities which are currently available.

ANGLING

Organised angling by means of day ticket or club membership is available on a number of sections of the Don and its two major tributaries, the Dearne and Rother.

Good fishing can now be enjoyed throughout much of the Don catchment with good brown trout sport to be

had in the Don above Penistone. Below Sheffield, the river becomes predominantly a coarse fishery which offers excellent sport for species such as roach, dace, barbel and chub. As the river becomes more canalised as a result of its use as a navigation, it begins to offer opportunities for organised match angling with species such as roach, bream and perch predominating. On the canal network below Doncaster there has developed one of the premier match fisheries in Britain, hosting many prestigious events annually.

WALKING & NATURE STUDY

FIVE WEIRS WALK

The Five Weirs Trust was established in order to ensure that the regeneration of the River Don became a central feature of the renewal of Sheffields east end and that public access to the 7.5km of river with its five magnificent and historic weirs was given back to the people of Sheffield. The aims of the Trust are:-

- to promote the idea of the walk in local planning policy and to ensure that sections of it are built as part of major construction projects on the Don wherever possible.
- to persuade local authorities such as Sheffield Development Corp. and the City Council to contribute to the achievement of the walk.
- to carry out construction of certain sections itself.
- to promote local community involvement in and 'ownership' of the walk and to encourage responsible recreational and educational use of it

75% of the walk is now completed or under way. Salmon Pastures is one of the 3 last remaining sections to be achieved to link Sheffield City centre and Rotherham Town centre. (For further information see Appendix IX, Case Study - Five Weirs Walk)

TRANS PENNINE TRAIL

A major route for walkers, cyclists and horse riders coast to coast, Liverpool to Hull via significant tracts of the valleys of the Rivers Don, Dearne and Rother. The trail was afforded EEC status by its formal adoption as the western extremity of 'E8', the major through route over continental Europe to Turkey. Millennium funds have been granted for its development and several sections of Environment Agency owned river bank are being used.

The improving ecology of the river corridor offers increasing opportunity for the enjoyment of the environment for bird watchers and naturalists. A number of sites adjacent to the river (as described in Part 2-Chapter 9) are now of national importance (managed by Yorkshire Wildlife Trust). New opportunities to encourage the return of once indigenous species of birds, animals and plants are constantly being sought and exploited. A good example of this is the work carried out at Old Moor Washlands near Wath Upon Dearne to create an exiting variety of wetland habitats.

PLEASURE CRAFT ON THE RIVER DON AT SPOTBOROUGH

BOATING

The navigation rights on the Don system are controlled by British Waterways and licences are obtainable from them for the use of craft on the waterways. The redevelopment of the Sheffield Canal Basin and the establishment of a number of marinas and mooring facilities on the Don system offer increasing opportunities to navigate between Sheffield and the River Trent via the Stainforth and Keadby Canal and to Goole via the New Junction and the Aire and Calder navigations. Work is also underway to open up the Chesterfield Canal and in the future it should be possible to navigate between Chesterfield and the River Trent at Stockwith.