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MAIDENHEAD, WINDSOR AND ETON FLOOD ALLEVIATION SCHEME

TOWN AND COUNTRY PLANNING ACT 1990

TOWN AND COUNTRY PLANNING

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WATER QUALITY

September 1992

Public Inquiry

NRA

National Rivers Authority

Thames Region

Maidenhead, Windsor and Eton Flood Alleviation Scheme

Water Quality Proof by I M Adams MA, MIWEM.

23 September 1992

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1 Introduction

1.1 Personal Details

1.1.1 I am Ian Michael Adams and I am the Environmental Quality Manager of the National Rivers Authority, Thames Region. I am a member of the Region's management team and am responsible to the Regional General Manager for a number of aspects of water quality in rivers, estuaries and ground waters including; pollution prevention, control and amelioration; water quality monitoring; biological monitoring; and enforcement action to maintain and improve water quality. I have held this post since September 1989. Before that from August 1984 I was the Principal Officer, Water Quality Planning, of Thames Water Authority and from 1974 I was successively the Assistant Divisional Manager (Scientific Services) of the Thames Conservancy Division of Thames Water Authority, and then Manager Pollution Control of Thames Water Authority. In these posts I was responsible for pollution control and water quality in the River Thames and its tributaries.

1.1.2 I am a Master of Arts of Cambridge University, having obtained honours in parts I and II of the Natural Sciences Tripos and specialising in chemistry in part II. I am a Member of the Institution of Water and Environmental Management.

1.1.3 I have over 25 years' experience of pollution control, over 20 of which have involved the management of water quality of the Thames catchment.

1.2 Scope of my Evidence

1.2.1 My evidence will describe the duties and responsibilities of the National Rivers Authority with regard to water quality and will also address the water quality aspects of the proposed flood alleviation scheme. I shall consider the current water quality of the River Thames and of the ground water in the Maidenhead area, the impact of the construction phase on these, and implications for the water quality of the River Thames and of the new channel once the scheme is completed and comes into operation.

1.2.2 I will show that the National Rivers Authority will manage the construction of the flood relief channel so as to prevent pollution of surface and ground waters. I will also show that the National Rivers Authority will be able to operate the scheme so as not to affect the water quality of the River Thames and to ensure that for most of the time the quality of the water in the new channel will be similar to that of the River Thames itself.

2 Responsibilities of the National Rivers Authority with Regard to Water Quality

2.1 Water Resources Act 1991

2.1.1 The functions of the National Rivers Authority are laid down in the Water Resources Act 1991. Part III of that Act deals with its powers and responsibilities regarding the control of pollution of water resources.

2.1.2 Sections 82 and 83 of the Act empower the Secretary of State to prescribe a system of classifying the quality of waters, and then to use that system to specify water quality objectives for any controlled water.

2.1.3 Section 84 of the Act imposes a duty on the National Rivers Authority to use its pollution prevention powers so as to ensure that those water quality objectives specified by the Secretary of State are achieved at all times.

2.1.4 Section 84 also imposes a duty on the Authority to monitor the extent of pollution in controlled waters.

2.1.5 Controlled waters are defined in section 104 of the Act and include the following categories which are relevant to this scheme:

inland freshwaters, that is to say, the waters of any relevant lake or pond or of so much of any relevant river or watercourse as is above the freshwater limit;

ground waters, that is to say, any waters contained in underground strata.

2.1.6 The new channel will be a relevant watercourse and thus a controlled water.

2.2 Corporate Objectives

2.2.1 NRA 64, NRA 65, and NRA 66 are the Authority's first three corporate plans published in September 1990, September 1991, and June 1992 respectively. The first page of the first plan contains statements of the Authority's Mission and of its Aims. The second of those aims is:

To assess, manage, plan, and conserve water resources and to maintain and improve the quality of water for all those who use it.

2.2.2 These aims were reiterated in the Authority's second and third corporate plans.

3 Water Quality Considerations

3.1 River Quality Objectives.

3.1.1 No water quality objectives have yet been established by the Secretary of State under section 83 of the Act. However, objectives were agreed between Thames Water Authority and the then Secretary of State in 1978 and 1979. These are still being used by the National Rivers Authority until formal objectives are set in accordance with the Act.

3.1.2 NRA 90 is a copy of a report which includes the system of river quality objectives published by the National Water Council (NWC). Appendix 1 of NRA 90 reproduces the report by the National Water Council entitled "River Water Quality - The Next Stage" (October 1978) which had been approved by the then Minister of State at the Department of the Environment. The recommendations of the National Water Council report were adopted by the Thames Water Authority in 1978, and river quality objectives were determined for all sizeable watercourses in the catchment. NRA 90 shows the river quality objectives throughout the catchment.

3.1.3 Page 5 of NRA 90 describes the National Water Council classification of river water quality in detail. This scheme is based on the current or potential class of the water, and attaches appropriate water quality

criteria or standards to those uses. I wish to draw particular attention to the uses ascribed to NWC classes 1A, 1B and 2.

3.1.4 Rivers in NWC class 1A are required to be of high quality suitable for potable supply abstractions and for all other abstractions, to support game or other high class fisheries, and to be of high amenity value. Rivers in NWC class 1B are required to be of a less high quality than those of class 1A, but to be usable for substantially the same purpose. Rivers in NWC class 2 are required to be suitable for potable supply after advanced treatment, to support reasonably good coarse fisheries, and to be of moderate amenity value.

3.1.5 As may be seen on page 8 of NRA 90, the river quality objective for the freshwater River Thames is that it should ultimately meet the objective of NWC class 1B for the whole of its length apart from the short reach from the Hogsmill River to Teddington, for which the objective is NWC class 2. The current objective for the River Thames in the area affected by the new channel is NWC class 1B.

3.1.6 The new flood relief channel once constructed will be a controlled water and an integral part of the River Thames and the National Rivers Authority will apply the same objectives to it as apply to the River Thames in the same area, that is NWC class 1B.

3.2 EC Directives

3.2.1 A number of Directives promulgated by the Commission of the European Community impose constraints on the quality of surface waters.

3.2.2 **EC Directive on the quality of fresh waters needing protection or improvement in order to support fish life (78/659/EEC) - NRA 117.**

This Directive was promulgated on 18th July 1978 and required member states to designate waters, within 2 years, as salmonid (those capable of supporting salmon, trout and grayling) and cyprinid (those capable of supporting coarse fish). The Department of the Environment appointed Water Authorities in England and Wales as "competent authorities", and required them to prepare a list of waters for designation under the directive. The competent authority is now the National Rivers Authority.

NRA 117 is a copy of a report which shows the Directive as Appendix I, and the list of waters designated under the Directive as Appendix II. The first page of Appendix II shows that the River Thames is designated as a cyprinid water for most of its length. Appendix I shows the water quality criteria which are applicable to salmonid and cyprinid waters designated under the Directive.

3.2.3 EC Directive on the quality required of surface water intended for the abstraction of drinking water (75/440/EEC) and the Directive on the frequencies of sampling and analysis of such water (79/869/EEC) - NRA 118.

The principal Directive (75/440/EEC) lays down quality standards for surface waters at the point of abstraction for public water supply. These standards depend on the method of water treatment to employed. The second directive specifies the frequency of sampling of such surface waters, and sets out reference methods of analysis to be used.

3.2.4 EC Directive on the protection of ground water against pollution caused by certain dangerous substances (80/68/EEC) - NRA 119.

This Directive, which was agreed in December 1979, requires member states to control discharges to ground water if they contain certain dangerous substances. It prohibits direct discharges of the most dangerous substances and requires careful investigation before wastes containing them are disposed of if this might lead to an indirect discharge.

3.3 Existing Surface Water Quality

3.3.1 NRA 91, NRA 127, and NRA 92 are copies of the Quinquennial Surveys undertaken for the Department of the Environment in 1980, 1985, and 1990. They show that the River Thames in the Maidenhead and Windsor area has consistently achieved its objective of NWC class 1B.

3.3.2 The river water monitoring programme carried out by my department shows that the River Thames consistently complies with the water quality standards specified in the EC fishery directive (NRA 117) from Eysey to Teddington, a distance of 222 km.

3.3.3 The water quality of the River Thames in the Maidenhead area is largely determined by the quality of the water flowing from the catchment upstream which is an agricultural one with a number of significant urban areas. There are 39 discharges from major sewage treatment works serving populations of 10,000 or more into the catchment above Cookham whose total average flow is 5.6 cumecs. They contribute a ninth of the total flow in the river under average flow conditions and substantially more when flows are low. The rest of the flow derives from base flow, run-off and smaller discharges.

3.3.4 Appendix A is a map showing the location of major abstractions and discharges between Cookham and Teddington. Between Cookham and Romney there are no major discharges directly to the River Thames. However, The Cut tributary which enters near Bray carries the effluents from Maidenhead, Bracknell, and Ascot sewage treatment works. The Boveney Ditch which enters below Boveney Lock carries the effluent from Slough sewage treatment works. The combined volumes of these effluents in dry weather is 70,000 cubic metres per day (0.8 cumecs).

3.3.5 Below Cookham the River Thames is a major source of water for public potable supply. Appendix A shows the location of the eleven existing intakes between Windsor and Teddington, which are operated by the following three water companies:

Thames Water Utilities at:

Datchet, Staines, Littleton, Walton, Hampton, Hampton (Thames - Lee tunnel), and Surbiton;

North Surrey Water Company at:

Chertsey, Egham, and Walton;

Three Valleys Water Company at:

Sunnymeads.

Of these Thames Water Utilities' Datchet intake is the first abstraction point below the new channel and is 1.65 km downstream from the point where the new channel rejoins the main River Thames.

3.3.6 The "surface water for abstraction directives" 75/440/EEC and 79/869/EEC (NRA 118) apply at the following points on the River Thames below Cookham:

Three Valleys Water Company Intake, Sunnymeads

North Surrey Water Company Intake, Egham

North Surrey Water Company Intake, Chertsey

North Surrey Water Company Intake, Walton

3.3.7 Appendix A also shows the location of a newly licensed public water abstraction at Bray for the Mid-Southern Water Company. This intake has not been constructed yet, but is due to be commissioned in the next few years. It is likely that the "surface water for abstraction directives" 75/440/EEC and 79/869/EEC (NRA 118) will apply to that abstraction point.

3.3.8 It is the duty of the National Rivers Authority to protect the quality of the River Thames so as to ensure that the quality of water at the intakes is suitable for potable supply after treatment by the abstractors.

3.4 Existing Ground Water Quality

3.4.1 The proposed flood relief channel is to be excavated in its upper reaches into the Chalk aquifer and for the rest of its course into the gravel aquifer of the upper Thames. Water is normally found within two to three metres of the ground surface and the channel will be excavated into saturated strata. This groundwater will contribute about 0.3 cumecs to the flow of the new channel and will thus have a potential effect on its water quality *(see para 5.1.1 of NRA 94)*.

3.4.2 To the south of the Taplow Mill Leat the channel route passes close to the old Taplow gas works site. In the past ground water below the site was found to be polluted by previous gas works activities. Long term works have been carried out to remove the polluted water using a scavenging borehole to abstract the water, and then discharge it to foul sewer. NRA 95 is a report entitled "Some Notes on Ground Water Quality on the Route of the Proposed Maidenhead Flood Channel from Taplow Pumping Station to Eton Wick (NRA October 1987)" which shows that no ground contamination has been found in this part of the channel route and ground water monitoring has not shown any significant contamination. Therefore this site will not exert an adverse effect on channel quality.

3.4.3 The land between Taplow and Dorney is used predominantly for intensive horticulture with associated heavy use of fertilizers. Of

primary concern is nitrate and NRA 95 shows that there is widespread ground water contamination along the proposed channel route, with nitrate concentrations up to 100 milligrammes per litre as nitrogen.

3.4.4 NRA 89 is a report entitled "Contamination Investigation at Slough Sewage Works (Wimpey Environmental, 1992)". It shows that to the north-east of Dorney the proposed channel route passes through Manor Farm where for several decades sewage sludge has been dried by spreading it over the fields. A small area is also used for storing and treating storm sewage. The sludge disposal practice has now ceased but has left a legacy of contamination in the soil, in the underlying ground and in ground water. The main contaminants in the ground are heavy metals, ammonia, nitrate and, in more localised areas, mineral oil. The principal contaminants of concern in ground water are nitrate and ammonia both of which were present in concentrations of up to 100 milligrammes per litre as nitrogen. NRA 89 shows that there is some evidence that these high levels have diminished somewhat since the cessation of sludge disposal.

4 The Impact of Construction on Water Quality

4.1 Surface Water

4.1.1 It is likely that the disturbance of the soil and gravel sub strata during construction of the channel will release quantities of nutrients into the water filled excavation. This will inevitably lead to algal growths as commonly occurs in any such water bodies. This is a temporary phenomenon which not affect existing controlled waters such as the River Thames. The algal growths will decrease with time and not affect the quality of either the channel or the River Thames by the time the channel is commissioned.

4.1.2 Run off from the Mineral Process Areas will be discharged to the Chalvey Ditch or the Salthill Stream. They will be treated before discharge via silt traps and oil interceptors in order to prevent any environmental impact on the two streams.The consent of the Secretary of State will be required under the provisions of the Water Resources Act 1991.

4.2 Ground Water

4.2.1 The Chalk and gravels form aquifers of major significance in the Thames Valley and abstractions for public supply are made from the Chalk aquifer at Taplow; from the gravel aquifer at Dorney; and from the Chalk aquifer at Datchet. There are also abstractions from the gravel aquifer for domestic supply at Dorney. Construction works will have no adverse effect on these abstractions with the possible exception of that at Taplow.

4.2.2 Construction works, particularly dredging, along the Taplow Mill Leat may have an impact on ground water quality, mainly by the introduction of suspended solids. Thames Water Utilities have abstraction boreholes for public supply at five sites along the Mill Leat (the Taplow group of pumping stations) and have indicated the extent of their interest in outline written representations. Discussions are taking place between the National Rivers Authority and Thames Water Utilities in order to satisfy them that their interests will be protected. This includes an assurance that the Taplow group of pumping stations will cease to be used during the construction period and alternative resources made available. It is anticipated that the quality of water abstracted by the Taplow group of boreholes will return to normal once disturbance of the river bed has ceased. Monitoring will be carried out to assess the degree and duration of any adverse effects and appropriate action taken to ameliorate them.

4.2.3 To the north-east of Dorney the proposed channel route passes through the Manor Farm site as described in NRA 89. Dr Walton describes how the contaminated material will be excavated and deposited in a waste disposal facility to be constructed on the Manor Farm site. It is anticipated that in total about 130,000 cubic metres of contaminated material, chiefly dried sewage sludge and soils remaining above the gravels, will need to be deposited in containment cells. The proposed structure will also accommodate sand to protect its base and sides and gravel from the top of the gravel layer to facilitate internal drainage of liquids and gases. The remaining gravel will be sampled and tested at the time of construction to ensure that residual levels of contaminants are acceptable to the environment.

4.2.4 The containment facility will be constructed using a synthetic liner overlying a prepared clay base 1 metre thick. The design will incorporate gravel and pipe drains within each cell to direct leachate to a sump from where it will be removed should levels become unacceptable. Suitable arrangements for leachate removal will be incorporated. A synthetic liner with a low permeability clay cap will be placed over the containment cells. Other spoil will be placed around the containment facility as described by Dr Walton to ensure the stability of the proposed structure.

4.2.5 All disposal of waste materials on site including spoil and contaminated soils, will require licensing under the relevant waste disposal

legislation, currently the Control of Pollution Act 1974 Part I. This has been the subject of discussion with Berkshire Waste Regulation authority with particular reference to the disposal of contaminated soils at Manor Farm and the design described in Dr Walton's proof accommodates the requirements of the regulating authorities.

4.2.6 The National Rivers Authority will adhere to this plan to ensure that there is no leakage of toxic material into the environment either during or after the construction of the channel. It will carry out all of the monitoring specified in the site licence, either itself or by employing suitably experienced contractors.

4.2.7 The relevant sections of my department have also examined the above proposal as they would any other application under Part I of the Control of Pollution Act 1974 to deposit controlled waste. They are satisfied with it.

4.2.8 Water used in the mineral processing operation will be recirculated and only discharged to the ground or watercourses if it is of acceptable quality. It is expected that the mineral to be excavated, including that from the section of channel through Manor Farm will not be contaminated. However, additional capacity of 25,000 cubic metres is available for disposing of any additional contaminated land. Waste silt from mineral processing will be regularly sampled and tested and disposed of in a similar way if it proves to be contaminated.

4.2.9 If any discharge of effluent into the ground is necessary it will require the consent of the Secretary of State for the Environment in accordance with the provisions of the Water Resources Act 1991. If the process water is contaminated it will be treated prior to discharge in order to comply with the terms of the EC Groundwater Directive (NRA 119) and with the general aim of the NRA to maintain or improve water quality. The discharge point will be chosen to avoid adverse effects on groundwater quality, with particular reference to local abstractions.

5 Water Quality Once the Scheme is in Operation

5.1 General

5.1.1 Any new development with an impact on river or ground water quality is appraised by the National Rivers Authority to ensure that the river quality objectives are maintained, appropriate EC Directives met, that the current uses are protected, and that its aim to maintain and improve the quality of water is achieved.

5.1.2 In order to assist the National Rivers Authority in its appraisal of the effect of the proposed flood relief channel, the Natural Environment Research Council was appointed as consultant to model the impact of the channel on water quality. The 3 month study was in 2 stages:

1. ground water quality modelling, and
2. surface water quality modelling, (including the modelling of algal growth).

I shall give brief details of these studies.

5.2 Surface Water Quality

5.2.1 NRA 94 is a report entitled "Maidenhead, Windsor & Eton Flood Alleviation Scheme Water Quality Study Final Report (NERC

Terrestrial and Freshwater Sciences Directorate, September 1990)". The appendix 2 to report NRA 94 gives details of a mathematical model called QUASAR, "Quality Simulation Along Rivers", a model developed in the 1980's and widely used by the Institute of Hydrology. The model was set up using data from 3 years 1976, 1984, and 1989. These years were chosen because they all had low flows. Times of low-flows are of most concern for water quality because there is less dilution available for the sewage effluent discharges into the upstream catchment.

5.2.2 The model was calibrated against real river quality data for these years. The model was modified to include the new channel and was then used to predict the water quality of both the main River Thames and the new channel for a variety of flows and potential operating strategies. The following determinands were modelled:

flow, biochemical oxygen demand (BOD), ammoniacal nitrogen, un-ionized ammonia, dissolved oxygen (D.O), nitrate, phosphate, and temperature.

5.2.3 The NRA intend to use this model to assist in managing the new channel and to this end it will be refined as more data becomes available.

5.2.4 The study showed that the quality of water in the new channel will depend on how it is operated. If flows of the order of 5 cumecs or

more are diverted into it from the River Thames then the water quality in the channel will be similar to that of the main River Thames. The results of the modelling also show that the quality of the main River Thames is unlikely to be affected by the diversion of a proportion of the flow into the new channel in accordance with the proposed operating regime except in very dry years such as 1976 which occur about once every 50 years. I shall cover the operation of the channel later in my evidence. Full details of the results of the modelling are described in NRA 94.

5.2.5 The study considered chlorophyll concentrations as indicative of algal numbers and shows that at times of low flow, chlorophyll concentrations in the River Thames typically exceed 100 microgrammes per litre. This is indicative of the substantial algal populations which commonly occur in the River Thames. Large algal populations, or blooms, are capable of producing large variations in dissolved oxygen between high day-time and low night-time levels. In addition large populations of some algae are of concern to abstractors of water for potable supply because they can cause problems during treatment.

5.2.6 The results of this study show that if zero or low flows persist in the new channel for periods of 30 to 50 days *(see para 7.4 of NRA 94)* there may be a risk of a change in the type of algae present and of blue-green algae becoming established in the channel. The report

further indicates that this risk will be minimal if flows in the channel are maintained at or above 5 cumecs.

5.2.7 At times of low flows, there may be insufficient flow in the River Thames to allow 5 cumecs to be diverted down the channel. This will occur when flows at Cookham fall to below about 11 cumecs for a protracted period. There have been 3 years since 1942 when such low flows obtained for a period in excess of 30 days. These were 1944, 1949, and 1976. They were exceptional years, and in years such as these the modelling studies indicate that the water quality in the proposed channel and that of the main River Thames may deteriorate.

5.2.8 I was responsible for pollution control of the Thames catchment above Teddington from 1974 and I have examined the water quality data for 1976 which is extensive. There is no indication that the effects predicted by the model under these extreme conditions occurred on the River Thames during that year. The Thames has numerous examples of parallel channels which mirror the arrangements proposed for the flood relief scheme between Maidenhead and Windsor. Typical ones are the Desborough Cut near Weybridge, and the lock cuts leading to Cookham and Old Windsor Locks. There were no problems due to low dissolved oxygen levels at any of these in 1976.

5.2.9 The NRA will manage the channel and the River Thames taking into account the predictions of the models and the actual quality observed in the channel. This is described in section 6.

5.3 Ground Water

5.3.1 The quality of ground water in the area has been subject to extensive mathematical modelling which was carried out in two separate stages. The first stage, to model conditions surrounding Manor Farm in the centre of the area, is described in NRA 96, a report entitled "Maidenhead, Windsor & Eton Flood Alleviation Channel: Groundwater Contamination Study: Phase 2 Modelling Study (RPS Environmental Services Ltd, 1989)". The second stage covered the remaining areas to the west and east of the central area and is described in NRA 94.

5.3.2 NRA 94 describes the AQUA computer program for modelling steady state flows and chemical transport in the saturated gravels in two dimensions, which is adequate for a shallow and relatively homogeneous aquifer. Abstraction from the gravel aquifer by the Thames Water Utilities' Dorney source was also modelled.

5.3.3 Physical hydrogeological parameters input to the model were derived from several sets of pumping tests in the gravels. Chemical transport

modelling was based on nitrate which was assumed to behave conservatively; that is, it was not subject to chemical or biological removal during its travel through the ground. Chemical input was derived from ground water and river quality monitoring and estimates of nitrate concentration water infiltrating from the surface of the ground. The model assumes that all sources of water and contaminants remain constant. This includes an assumption of continued sludge spreading at Manor Farm which in fact ceased in 1990. Therefore the levels of contaminants will be less than those which the model predicts.

5.3.4 Nitrate is the contaminant of primary concern, since it is a plant nutrient which will encourage the growth of algae in water. It is present in a concentrated plume across the western side of the central section, north of Dorney. Maximum nitrate concentrations of the order of 20 milligrammes per litre as nitrogen are predicted to enter the channel from ground water.

5.3.5 The significant pollution by ammonia of the ground water in the area of Manor Farm will be eliminated in the area of the channel by the action described earlier (section 3.4). The model predicts that, with the high rates of flow in the gravels, any remaining polluted ground water to the south of the channel at Manor Farm will be displaced southwards within months.

5.4 Water Plants

5.4.1 Periodically the River Thames becomes affected by floating plants such as duckweed and water fern. It is likely that the channel will be affected similarly.

5.4.2 There are four species of duckweed (*Lemna*) of which *Lemna minor* is the one most frequently encountered. It has caused problems to boat inlets on the lower River Thames (1989) and to fishermen in the River Mole and still waters in the Thames region. It is a higher plant (angiosperm) having small flowers and producing seeds, but its main method of reproduction is asexual division of the floating leaf. It is most successful in stiller, more protected environments. Nutrient enriched waters also cause faster growth of *Lemna* mats. One of its major effects is in its accumulation and decomposition creating low oxygen conditions unsuitable for fish.

5.4.3 The water fern (*Azolla*) was imported into the U.K. as an aquarium plant which has subsequently escaped to the wild. It floats on the surface and under warm-water conditions (ie. summer temperatures) it can spread extremely rapidly. It is frost-sensitive, so dies back in the winter and may cause local low dissolved oxygen levels to occur as the plants decompose.

5.4.4 Both *Lemna* and *Azolla* can grow rapidly in still or slow flowing waters in the South of England. Hot summers and dry winters encourage both of them. Both of these floating plants inhibit fixed rooted plants and limit faunal diversity by this inhibition. Control is difficult, there are few natural predators in the U.K., chemical control is not easy for physiological as well as legislative reasons, and physical removal is arduous.

5.4.5 There could be significant growths particularly of *Lemna* in the new Maidenhead Flood Relief Channel under conditions of low flow which occur in years similar to 1976. However under such conditions similar growth would occur in other reaches of the Thames and in its tributaries. I will describe measures to alleviate any problems later in my evidence.

6 Water Quality Management in Low Flows

6.1 Monitoring

6.1.1 The channel will be monitored by two new fixed automatic quality monitoring stations similar to those already tried and tested in the Thames Region. In addition the Thames itself will be monitored by the existing station at Romney Lock and by new stations at Taplow and in the vicinity of the new Mid Southern Water Company abstraction at Bray. Their locations are shown in appendix B. Information from these stations is transmitted hourly to the Region's head office at Reading where it is processed and made available for management purposes.

6.1.2 Routine monthly samples will be taken for chemical analysis from the Thames at Cookham Bridge, Boveney Weir, below the Boveney Ditch confluence, Sunnymeads Intake, and at the locations of the Automatic Quality Monitoring Stations as part of the normal regional river quality monitoring programme. Monthly samples will also be taken at Bray as soon as the new water intake is put into operation.

6.2 Management Action

6.2.1 If any pollution event is detected from this monitoring or reported through any other source then the provisions of our normal Pollution Incident handling procedures will be activated. These are described in NRA 93, the Environmental Quality Emergency Procedures manual issued in April 1992.

6.2.2 In times of low flow when water quality may be at risk as I have described previously in section 5.2, the automatic quality monitoring stations will give an hourly picture of the situation. This will enable management decisions to be taken as soon as any problem arises and in particular to:

a) increase the frequency of manual chemical monitoring in each reach; and,

b) carry out visual inspections of the watercourse; and,

c) commence biological monitoring of algal population and growth of macrophytes such as *Lemna*; and,

d) enable remedial action to be put in hand.

6.2.3 Examples of remedial action include:

Adjusting the flow distribution on a temporary basis,

Providing local aeration by portable equipment,

Removing troublesome weed growths.

6.2.4 The remedial action necessary will depend on circumstances, but experience of managing the Thames system during the low flows of 1976 and 1990 indicates that any such action will probably need to be only limited in its extent. There is no reason to think that it will not be effective.

7 Conclusion

7.1 I have laid out the duties and responsibilities of the NRA with respect to water quality.

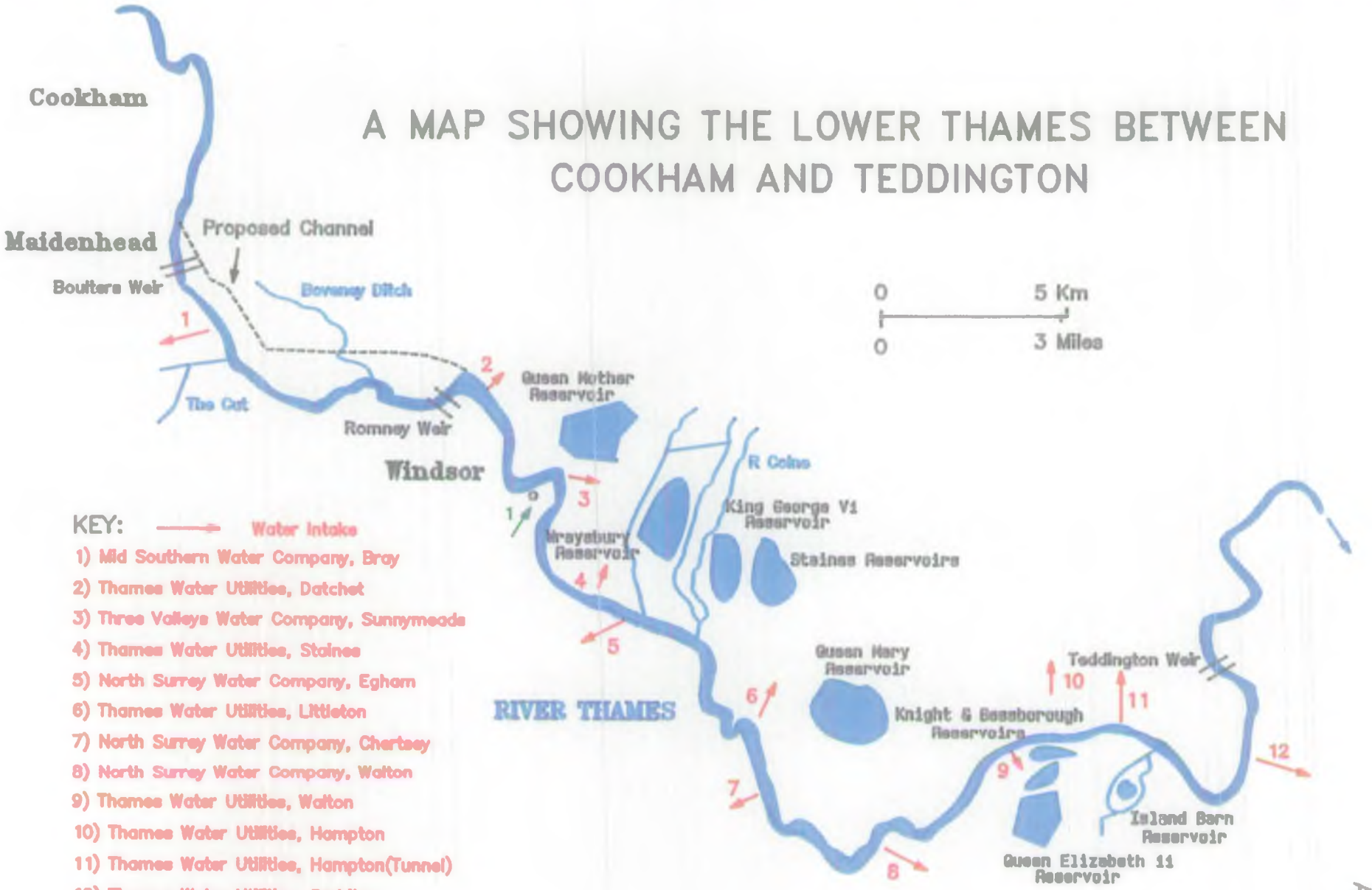
7.2 I have described the current water quality of the River Thames and the ground water in the Maidenhead area.

7.3 I have demonstrated that the NRA has considered and allowed for the effects of the construction of the channel on water quality and its associated use.

7.4 The NRA has gone to considerable lengths to consider the implications of the proposal for the long term quality of the River Thames and the new channel. I have described the conclusions of these studies.

7.5 I have described arrangements for the monitoring and management of river quality in the new channel and shown that the NRA will operate the new facilities to optimise water quality and protect current users.

A MAP SHOWING THE LOWER THAMES BETWEEN COOKHAM AND TEDDINGTON



KEY:

Water Intake

1) Mid Southern Water Company, Bray
2) Thames Water Utilities, Datchet
3) Three Valleys Water Company, Sunnymeads
4) Thames Water Utilities, Staines
5) North Surrey Water Company, Egham
6) Thames Water Utilities, Littleton
7) North Surrey Water Company, Chertsey
8) North Surrey Water Company, Walton
9) Thames Water Utilities, Walton
10) Thames Water Utilities, Hampton
11) Thames Water Utilities, Hampton(Tunnel)
12) Thames Water Utilities, Surbiton

Discharge

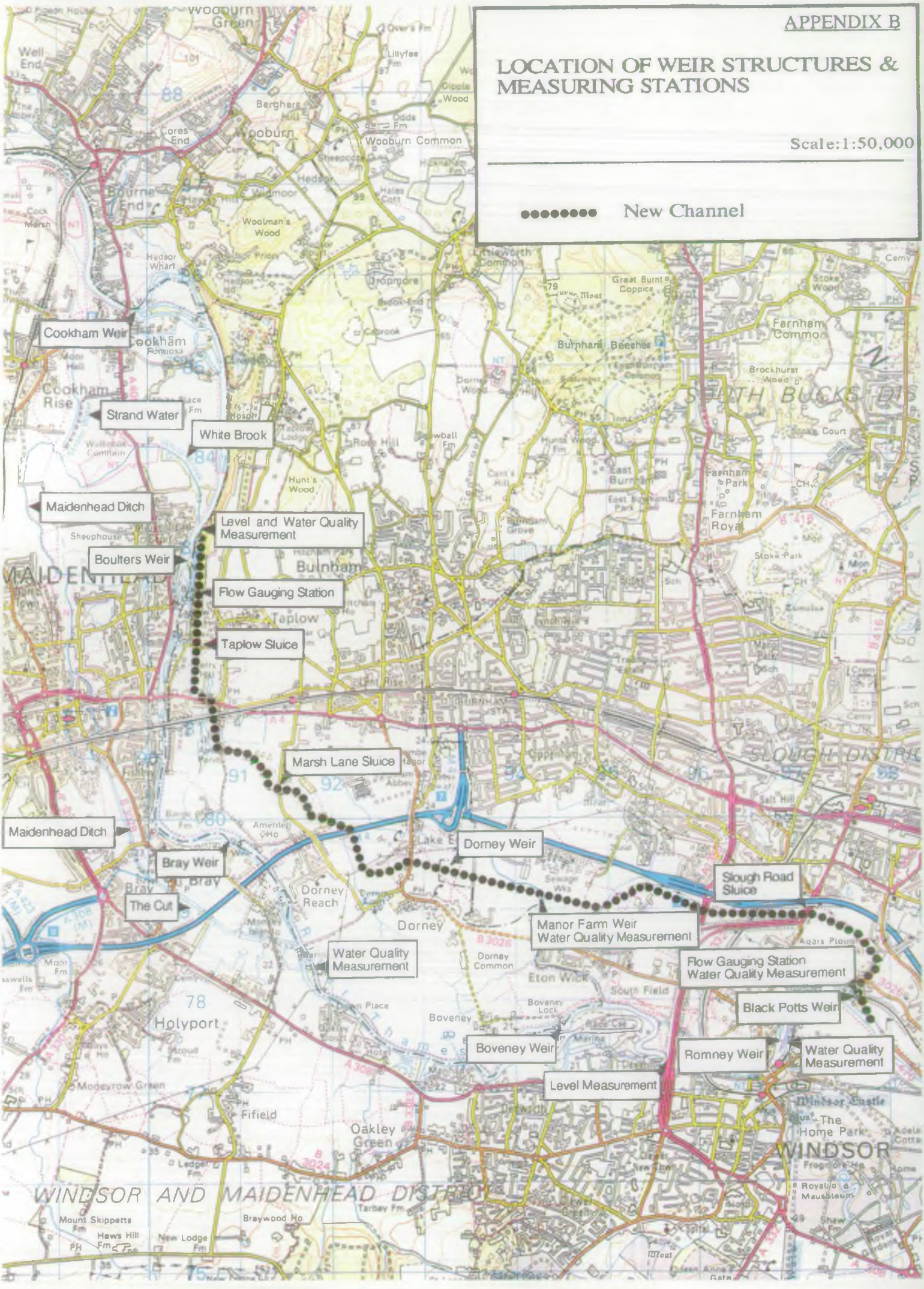
1) Windsor Sewage Works

APPENDIX B

LOCATION OF WEIR STRUCTURES & MEASURING STATIONS

Scale:1:50,000

●●●●●●●● New Channel



GLOSSARY OF TERMS

Algae

Simple plants which may be microscopic, or very large plants but which lack true stems, all of which are capable of photosynthesis. Algae occur in water and are often discussed in the context of Eutrophication.

Ammonia (total)

A chemical found in water, often as the result of discharge of sewage effluents. High levels of ammonia affect fisheries and abstractions for potable water supply.

Aquifer

Layers of underground porous rock which contain water and allow water to flow through them.

Base Flow

The flow in a river due to seepage through the ground, to distinguish it from direct run-off from the surface and flows from discharges.

Borehole

A vertical hole drilled into the ground to gain access to water (similar to handmade wells in the past).

BOD and BOD (ATU) - Biochemical Oxygen Demand

A measure of the amount of oxygen consumed in water, usually as a result of organic pollution. The simple BOD value can be misleading because much more oxygen is taken up by ammonia in the test than in the natural water. This effect is suppressed by adding a chemical (allylthiourea) to the sample of water taken for testing, hence, BOD (ATU). Without ATU, the BOD is "uninhibited".

Chemical Classification

A way of placing waters in categories according to assessments of water quality, based on measurements of the levels of particular chemicals in the water (especially BOD, dissolved oxygen and ammonia).

Chlorophyll

Green and yellow pigments in all "green" plants which can be measured and used as an indicator of number of algae present.

Competent Authority

An organisation designated by the Government as being responsible for the implementation or operation of a Directive.

Compliance Assessment

A procedure applied to the results of a monitoring programme to determine whether or not a water has met its agreed Quality Standards.

Controlled Waters

All rivers, lakes, groundwaters, estuaries and coastal waters to three nautical miles from the shore.

Cyprinid Fish

Coarse fish like roach, dace and bream.

Dangerous Substances

Substances defined by the European Commission as in need of special control because of their toxicity, bioaccumulation and persistence.

Directive

A type of legislation issued by the European Community which is binding on Member States in terms of the results to be achieved.

Dissolved Oxygen

The amount of oxygen dissolved in water. Oxygen is vital for life so this measurement is an important, but highly variable, indicator of the "health" of a water; it is used to classify waters.

Determinand

A general name for a characteristic or aspect of water quality; usually a feature which can be described numerically as a result of scientific measurement.

Ground Water

Underground water especially in or from aquifers.

Heavy Metals

Metals such as mercury, lead, cadmium, copper and chromium that have a high atomic weight. Some of these can be lethal to aquatic life in minute quantities.

Leachate

The seepage of liquid through a disposal site or spoil heap.

Mathematical Model

A representation of reality in mathematical terms, usually made on a computer.

NWC Class

A summary of quality of river water based largely on the measured chemical quality for the purposes of classification and reporting; originally devised by the National Water Council in 1977.

95-percentile

A level of water quality, usually a concentration, which is exceeded for 5-percent of the time.

95-percentile Standard

A level of water quality, usually a concentration, which must be achieved for at least 95-percent of the time.

Nitrate

A chemical found in the water and formed naturally in the soil by micro-organisms. It is an essential nutrient for plant growth. It is also produced industrially and used as a fertilizer. Too much nitrate in water can lead to excessive growth of plants in the water. The amount of nitrate in drinking water is limited by the European Community.

Nutrient

A chemical essential for life. If present in excess concentration, nutrients can cause problems by promoting algal growth.

Permeability

The ease with which water moves through an aquifer ie the rate of flow of ground water through unit cross-sectional area of an aquifer. It can be measured in centimetres per second or metres per day.

Phosphate

A form of the element phosphorous that plays an essential role in the growth and development of plants and animals. In rivers, the main source of phosphate is treated sewage effluents. (It is widely used in household detergents.) Too much phosphate can give rise to excessive growth of plants, especially algae, in water.

Quality Objective

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

Salmonid Fish

Game fish, eg trout and salmon.

Scavenging Borehole

A borehole drilled specifically to abstract water from a contaminated aquifer.

Standard

A level of a substance or any calculated value of a measure of water quality, which must be met in order to protect a given use of a water body. The standard is expressed as a pairing of a specific concentration or level of a substance with a summary statistic such as a 95-percentile (ibid) or a maximum.

Suspended Solids

If a sample of water is taken, dried, and filtered, the particles remaining on the filter paper are known as suspended solids. It is usually measured by drying at 105°C and recorded in milligrammes per litre.

Un-ionized Ammonia

A form of ammonia that in small concentrations is toxic to fish. It is a small part of the total ammonia depending on the temperature and acidity of the water.