



## **Appendix E**

### **Scottish Water's review of the water quality programme comments**

**WICS REPORTER SERVICES  
STRATEGIC REVIEW OF CHARGES 2006  
Second Draft Business Plan**

**REPORTER'S REPORT  
Appendix E**

**SCOTTISH WATER'S WATER QUALITY FEEDBACK**

The following report was issued to the Reporter by Scottish Water to provide feedback on comment's made by the Reporter following his audits of the Water Quality Programme. Scottish Water has agreed that it may be incorporated in the Reporter's Report.

**RECORD OF ISSUE**

<b>Issue</b>	<b>Date</b>	<b>Description</b>	<b>Prepared</b>	<b>Checked</b>	<b>Approved</b>
1		Preliminary issue to WICS			
2	20/06/05	Incorporated as Appendix D of Reporter's Report			

**Scottish Water Overview of Water Quality Programme  
Feedback on Reporter Audits  
31<sup>ST</sup> March 2005**

**UPDATED TO INCLUDE D. JOHNS COMMENTS  
21<sup>ST</sup> APRIL 2005**

**UPDATED TO INCLUDE ADDITIONAL SW COMMENTS  
20<sup>TH</sup> MAY**

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## Executive Summary

Following Reporter audits of a number water treatment works, Scottish Water (SW) was requested to review the Investment Programme F2. A number of key areas were raised by the Reporter and his team.

In the limited time available a review of the top 50 works (by investment) together with a review of the Nanofiltration (NF) plants was undertaken. In addition a separate review of existing washwater recovery provision was undertaken.

SW concurs with the Reporter that there were some investment areas with a degree of over scope in the programme. In particular some NF plants were specified in places where the drivers do not justify it. In addition waste tanks had been provided as part of the scope which appear to be in excess of current SEPA requirements. There are however areas within the scope of NF plants, where they are justified, that potential under scope exists, mainly around the assumed recovery rate of large membrane plants (>1.5Ml/d) and the extent of pre-treatment provision.

SW disagrees with the Reporter's concerns regarding the provision of lamella washwater recovery systems. There is insufficient quantitative information available to support the Reporter's assertion that existing washwater recovery plants are capable of providing adequate quality returns to the inlet of the works. Furthermore, SW considers that the technical merits of the proposed lamella washwater systems are justified to meet the requirements of the cryptosporidium direction and current best practice. Site specific reductions have been applied to address potential duplication of ancillary plant and equipment such as pumping stations.

SW identified a degree of overlap with Q&S2 as a result of further visibility of the solutions proposed in Q&S2 since development of the 1<sup>st</sup> draft business plan. Site specific reductions have been applied as a result of this review.

SW also identified areas of under scope within the programme. There are site specific issues and category issues that have under scope. In particular the allowances for power, buildings and access roads appear to be low across the programme – particularly for the small remote sites. No adjustment has been made for this.

While SW would agree that on some of the specific issues raised by the Reporter the programme appears to be over scope, there are other areas within the programme that appear to balance this with under scope.

As costs have not been considered as part of this report the extent of any under or over scope needs to be assessed further by the Q&S3 team.

Other areas of potential risk to Scottish Water including some of which were raised by the Reporter do not appear in the Reporter's draft report. These include:

- Success of enhanced coagulation in addressing trihalomethanes.
- Declared lack of investment for turbidity indicator value of 1 NTU ex works. All investment for turbidity driver is against 4 NTU PCV.
- Life-cycle replacement of NF membranes – 7-year cycle adopted by SWS which does not align with SW experience of 3 to 4-year cycle. Potential underestimation of capital maintenance.

## Introduction

Following Reporter audits of a number water treatment works a team of Scottish Water staff were requested to review the Investment Programme (Plan F2). This report comprises the findings of this review. Based on the findings of this review the costs that were carried forward into the Second Draft Business Plan were moderated.

In preparing his report, the Reporter noted the review process undertaken by Scottish Water. Whilst the review addressed a number for the Reporter' concerns there remained some differences of, for example, technical opinion. He offered Scottish Water the opportunity to include this report as an appendix to his own report. This document has been updated and issued for this purpose. It should be noted that this document does not constitute a full statement of all Scottish Water comments on the Reporter's draft report.

A number of key areas were raised by the Reporter and his team. The areas dealt with in this report are:

- Clean Backwashwater Tanks
- Washwater recovery
- Nanofiltration Plants (including wastewater holding tanks)
- Clear Water/Contact Tanks
- Secondary Treatment for Manganese Removal
- General view on under and over scoping
- Q&S2 overlap
- Flow and Quality Monitors (FQM)
- Over scoping of chemical dosing
- Appropriateness of allowances for miscellaneous items (access roads, provision of power)

In the limited time available a review of the top 50 works (by investment) together with a review of the Nanofiltration plants was undertaken. In addition a separate review of existing washwater recovery provision was undertaken. This review was based on historical water quality data, knowledge of the Q&S2 programme, knowledge of the works in question and utilised data from preparation of the water quality programme. The review has been carried out at a programme level and did not consider site specificity. In order to maintain objectivity, costs were disengaged from the process. Costs were addressed by others in the Q&S3 team.

## Backwash Tanks

The lack of Clean Backwash Tanks on existing works leads to significant problems downstream of the filters. On sites without Clean Backwash Tanks, when a filter backwashes, the water comes direct from the filtered water main. The result is that most if not all of the forward flow from the filters to the next stage (often disinfection) falls sharply or even stops. This has knock-on effects, with down-stream chemical dosing such as pH elevation and disinfection not being able to flow pace. Overdosing often results due to limitations on turndown on dosing pumps and analytical equipment. This is one of the principal reasons why many of the larger WTW's have issues with Disinfection Control.

## Washwater Recovery

The Reporter has highlighted a number of concerns with the application of the washwater recovery driver. These are as follows:

- Washwater recovery specified on sites with existing systems
- Technical solution proposed i.e. lamella recovery system
- Cost of the proposed solution against conventional washwater settling systems
- Footprint required not available on some sites visited

The Cryptosporidium Direction (Scottish Water) 2003 requires that where washwater is returned to the head of the works it must be adequately settled and returned upstream of the coagulation dosing point. There is a further expectation from DWQR that SW operates its water treatment plants in line with current best practice. UKWIR best practice for washwater recovery systems stipulates that water returned should have turbidity less than 10 NTU and at volumes less than 10% of the overall inlet flow.

Large water treatment works within SW have been designed and constructed over the last 10 – 15 years. A large number of these works utilise coagulation, a clarification stage and one or more stages of filtration. These works have been designed to varying design standards in place in the predecessor authorities and constructed by a number of different contractors. The majority of these sites utilise conventional washwater recovery systems consisting of settlement tanks that operate on a batch basis of fill/settle/return. These systems were not designed to a quality standard and there is limited water quality data to determine how these plants are currently operating.

The Reporter's team, during their site visits concluded from visual inspection and unsubstantiated anecdotal information that certain washwater recovery systems appeared to be suitable and would comply with the requirements of the Cryptosporidium Direction.

A separate review of washwater recovery systems carried out by SW gathered available data from operational sites.

From this review it is apparent that there are a number of sites where the washwater recovery is ineffective or does not comply with current best practice.

- Washwater is not returned to the head of the works at nearly all treatment works in Dumfries and Galloway. There are other works across SW where washwater is not currently recovered due to quality issues.
- 50% of WTW assessed have insufficient WWR assets i.e. 2 recovery tanks where best practise is for 3 (fill/settle/return)
- A number of works return washwater at the incorrect point – i.e. downstream of coagulation dosing
- A number of works return WWR to the inlet in excess of the permitted volume
- Enhanced settlement (i.e. polymer assisted settlement) is only practised at 4 sites
- Sites with 2 stages of filtration do not have sufficient washwater capacity to recover washwater and take account of differing pH of the filtration stages
- Major sites in NE area return unsettled supernatant from thickeners to head of works

The conclusion of the review of SW sites is that there is sufficient uncertainty in the performance of the existing washwater systems. In addition there is insufficient understanding of the scope of works required to improve washwater recovery system performance to warrant any wholesale reduction in the scope currently identified in the programme.

SW policy will need to be revised to make best use of resources (in line with principles of WFD) and will re-circulate washwater where practicable. The introduction of a robust

washwater recovery system will not only safeguard water quality but will also ensure the most effective use of resources.

In relation to the technical issues raised by the Reporter regarding appropriateness of the lamella approach, we refer to SWS / UU technical rebuttal previously submitted. This is an approach that UU have adopted based on pilot trials and has been installed at a number of sites in their operation area. This technical approach is included in their AMP4 programme and has gained support from DWi as a robust technical solution to minimising the risk of cryptosporidium contamination from washwater return. In addition other water companies are looking at adopting this approach in their AMP4 programmes. SW support the technical assessment outlined in this rebuttal.

It was also highlighted by the Reporter that the proposed design for lamellas was a single stream continuous process. The design proposed by SWS and utilised in UU is a multi stream process based on proportional flows.

This report does not consider the aspects of the comparative cost of lamella washwater recovery against conventional washwater settlement processes as the SW position is that lamella separators are an appropriate technical solution.

A programme level adjustment in respect of lamella overscoping was made following this review.

### **Nanofiltration Plants**

The review of nanofiltration (NF) plants was based on the Reporter review of Newburgh WTW which had a nanofiltration plant specified without the drivers to justify it.

On review of the nanofiltration plants 10 potential Q&S 2 overlaps were identified and 17 with no drivers to justify selection of NF adopting strict use of the decision tree and process selection matrix were identified.

This was reviewed with SWS and it was stated that the cost difference on small plants (< 1MI/d) between microfiltration (MF) and NF was minimal and that NF offered a greater degree of protection. This assertion requires to be validated.

It is accepted that there is a degree of over scoping in this element of the programme. Notwithstanding this there is still a requirement for some form of treatment on these 17 sites – Microfiltration or coagulated direct filtration. It should be noted that 11 of the works where NF is not justified are less than 1 MI/d.

An additional item identified by the Reporter was the provision of dirty washwater holding tanks. Review of the scope has determined that these are provided in excess of current SEPA requirements, based on anecdotal information from individual sites. The only current formal SEPA requirement for waste tanks on membrane plants is for chemical washing of the membranes.

The holding / balancing tanks at NF works are provided to enable the membrane backwashing process to take place in a consented manner. It is not unreasonable to assume that normal operation on all new NF sites will be similar to existing consented sites and consist of:

- discharging reject water directly into the watercourse downstream of the point of abstraction

- non-chemical membrane dirty backwash water to balancing tank with sufficient detention time to permit return over 24 hrs plus.
- chemical membrane dirty backwash to blind holding tank for tankering off-site.

SW believes this prudent approach aligns with that taken on other SEPA related issues such as investment connected with WFD drivers.

One area of the nanofiltration plants that is potentially underscoped is the differentiation between NF1 and NF2. NF2 works on the assumption that existing treatment can be utilised as pre-treatment for the membrane process. No assessment has been made to the efficacy of the existing treatment as part of the investment planning process. Experience of membrane plants in SW suggests that the pre-treatment is critical to the protection of the membrane and it is not certain that the existing treatment on site will provide effective screening or load reduction for the membranes. NF1 (which includes for new pre-treatment) may be a more prudent approach.

SW had previously expressed concern that the recovery rate stated for the membrane plants was higher than experienced in SW. In discussion with SWS, they have advised that membrane plants < 1.5MI/d are based on SW assets and have therefore been costed on the SW recovery rate of 60 – 70%. There is still some concern that there is a degree of undersizing on larger plants.

### **Clearwater / Contact Tanks**

The term Clearwater Tank is used to describe both Contact Tanks and also Clean Backwash Tanks for filters, not Clearwater Tanks provided for increased storage of final water. Where there is a requirement for a new Clean Backwash Tank, it will always be a new stand alone item and not adding to any existing volume.

When there is a requirement for a Contact Tank, trying to retro-fit an extension to an existing Contact Tank is in our experience just not feasible. On smaller WTW's, the cost of trying to add to an existing tank normally always results in a higher cost than a stand alone new tank. On larger WTW's, where on the face of it, there might be a better cost differential due to the size of the tank, the work would have to be carried out on-line, as larger works cannot normally shut down. This then results in longer construction periods and significantly elevated risks to SW whilst the works is carried out on our existing Contact Tank. These tanks cannot be taken off line whilst the works is in operation.

### **Secondary Treatment for Manganese Removal**

If there is manganese in the distribution system, it must have been in the raw water and passed through the works. Without a dedicated secondary removal system, there is still the potential for this to continue. If the proposal being put forward is based on a seasonal cleaning of the distribution network, SW would consider this to be a high risk approach due to the well documented problems with the successful physical removal of the various layers and forms, both biological & chemical, of Manganese from the pipe surfaces. The sheer size of many distribution systems would also generate very high Opex which has not been included in the business plan.

In addition DWQR have expressed dissatisfaction in network managed solutions as demonstrated by their attempted prosecutions of SW in North Ayrshire for manganese related incidents.

## **General Overview of Under and Over Scoping**

In the review of the top 50 sites an assessment of the level of potential under and over scoping was made.

This considered whether the proposed solutions were appropriate for the drivers specified and whether drivers or site specific issues had been considered.

The conclusion of this review is that 18 sites were under scoped, 3 were over scoped and 4 had a degree of under and over scope depending on the driver considered.

On a wider level, it is important to note that often there are only Regulatory samples regularly taken at many SW sites. This gives a limited indication of the performance of a treatment works. Any PCV failure is reported to the DWQR and if the failure extends to more than 30 days per year, an Authorised Departure will have to be applied for. Because of this, any failure is treated as indicative of problems at the plant, and the necessary remedial actions proposed.

The Water Quality Regulations 2001 call for “likely to fail” trends to be reported to the DWQR in the same manner as actual failures. A failure at a works in an operational sample that does not manifest in a failure at the customer’s tap could still be classed as a “likely to fail” as it is highly unlikely that any water leaving a WTW will improve through the distribution system Authorised Departures may well be required in respect of zones with likely to fail parameters.

The logical conclusion to this is that the DWQR may well expect work to be carried out on these site(s) to prevent an actual breach of the PCV – work which under this approach has not been budgeted for.

Regarding “marginal” failures - the fact that something just fails the PCV still means it has failed a regulatory limit that has been set to ensure public water supplies are wholesome.

The lack of statistical trend analysis arising from the above means that SW may well have under estimated this area of investment need.

## **Q&S2 Overlap**

As part of the review overlap with Q&S2 was reviewed. This went beyond the top 50 sites but did not cover all sites. In total (including NF plants) 42 sites were identified with potential overlap. Further validation was required to determine the extent of the overlap on these projects and was carried out by the Q&S3 team.

## **Flow and Quality Measurement (FQM)**

FQM is driven by the need to improve process control associated with disinfection processes. Concern has been expressed by the Reporter that this duplicates flow and quality control already on site. It is accepted that from the Process Block Diagrams this appears to be correct. There is a concern however that the existing equipment on site may not be suitable to provide sufficient levels of control to improve the effectiveness of the disinfection process and to minimise the level of complaints associated with disinfection by-products. Without clarity from both DWQR on how this element will be measured and quantified and an

understanding of the level of effectiveness of the existing equipment and processes it is difficult to make an assessment of whether this is over scoped.

### **Chemical Dosing**

The Reporter has highlighted that the Enhanced Coagulation Dosing standard design has both acid and lime dosing and a static mixer for each chemical. It is accepted that acid and lime dosing would be the exception rather than the rule. It is also accepted that where acid and alum were dosed, a single static mixer could be utilised. However this would result in a limited reduction in the programme as lime is the default pH adjustment chemical rather than acid. This configuration with alum as the coagulant would require separate mixers for the chemical addition to ensure that the necessary reactions have taken place prior to adding the next chemical.

### **Appropriateness of Allowances for Miscellaneous Items**

A limited review of the site allowances for miscellaneous items such as power, buildings and access roads has raised some concern that across the programme there is an overall under allowance for these.

The allowance for these has not taken account of site specific issues, but instead is based on algorithms linked to plant flow.

For example power is based on an assumption that there is sufficient power available locally and that the connection is to nearby transformers. The maximum allowance for power on any individual site is £63,000. A number of the sites in North West are remote and power supplies are not available locally. In these cases the power costs are unlikely to cover the cost of extending suitable power supplies to the location of the new works.

Standby Generators have only been included in Q&SIII projects that incorporate major new stages of treatment, such as Clarification and Rapid Gravity Filters. The empirical graph of kVA VS MI/d is derived from these exact types of WTW and represent what will be typically be required to be covered by Standby Generators on such WTW's. Originally, Standby Generators were applied to most projects, no matter the project type and scope but since the basis of application has been refined (all in accordance with the originally issued Methodology), the application and sizing of the Standby Generators is correct.

Another area that is likely to be underestimated is the allowance for access roads. This is based on a minimum of 200m<sup>2</sup> plus a factor per MI. For example a 7MI/d works would have 235 m<sup>2</sup>. Again for some small remote sites are currently accessed by quad bike on rough tracks, the allowance for access roads is likely to be less than the actual requirement.

Overall it is likely that the allowance for access roads, power and buildings is too low to cover the level of investment required.

### **Conclusion**

In conclusion SW has reviewed the investment programme focusing on issues raised by the Reporter and his team during site audits.

SW concur with the Reporter that there are areas of with a degree of over scope in the programme. In particular the NF plants are specified in places where the drivers don't justify it. In addition waste tanks have been provided as part of the scope which appear to be in error. There are however areas within the scope of NF plants, where they are justified, that

potential under scope exists, mainly around the assumed recovery rate of large membrane plants (>1.5MI/d) and the extent of pre-treatment provision.

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While SW would agree that on some of the specific issues raised by the Reporter the programme appears to be over scope, there are other areas within the programme that appear to balance this with under scope.