MODELLING SEWERAGE SERVICE COSTS

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1. The Drivers for Cost Modelling

The Northumbrian Water region has a long coastline, which stretches from the North Yorkshire Moors to the Scottish Border. The majority of the population centres and industry in the North-East of England are situated close to the coastline. Historically, the sewage and trade effluent from these locations was discharged to the North Sea without the need for secondary treatment.

Throughout the 1990's Northumbrian Water had undertaken a £700 million investment programme, largely in response to EU legislation, to improve the level of treatment along the coastline. By the end of 2001, all but the smallest coastal wastewater treatment works, were providing primary, secondary and (in some cases) tertiary treatment.

Prior to this investment in the coastal works, less than 40% of the trade effluent from all Northumbrian Water's customers received secondary treatment. The introduction of secondary treatment in 2001 increased the amount receiving secondary treatment to almost 100%. Northumbrian Water wanted to review the impact on the cost-reflectiveness of trade effluent tariffs of this step change in treatment levels in 2001.

2. The Objectives of Cost Modelling

Northumbrian Water asked Entec to develop a cost model for trade effluent treatment. There were three main objectives:-

- To identify the actual costs of treating trade effluent;
- To assess the cost-reflectiveness of trade effluent tariffs;
- To recommend any changes required to tariff structure or level.

3. How the Model was Developed

The following key issues guided the development of the cost model:

ACTUAL COSTS meant that the model had to deal with the costs incurred at individual sewage treatment works.

TRADE EFFLUENT meant that the model had to be able to separate trade effluent costs from domestic sewage and surface water run-off related costs.

COST-REFLECTIVE meant that the model had to deal with all the costs, i.e. related to works operation, maintenance and capital expenditure, which were recovered through the tariff.

3.1 Selection of Wastewater Treatment Works

Northumbrian Water operates more than 400 wastewater treatment works. However, only 61 works receive any trade effluent, with the large majority of the load treated in a much smaller number of works. In fact, 17 wastewater treatment works receive >95% of all the trade effluent generated in

Northumbrian Water's region. Thus, it was clear that analysis of these works (listed below) would provide a robust basis for understanding trade effluent costs:

- Howdon
- Bran Sands
- Hendon
- Horden
- Seaton Carew
- Cramlington
- Aycliffe
- Billingham
- Berwick
- Cambois
- Washington
- Browney
- Marske
- Tudhoe Mill
- Sedgeletch
- Barkers Haugh
- Newbiggin

Prior to this investment programme these 17 works provided a range of treatment levels, i.e. from unscreened outfalls to tertiary treatment. By the end of the investment programme all these works provided at least secondary treatment. The selected wastewater treatment works varied considerably in size, with the largest receiving several thousand per annum of trade effluent COD load and the smallest receiving less than 10 tonnes per annum.

3.2 Analysis of Cost by Type

For all wastewater treatment works there are four main categories of cost that have to be recovered in tariffs;

- Direct operating costs;
- Indirect operating costs;
- Capital maintenance, and;
- Return on capital investment.

Direct Operating Costs details were available for each sewage treatment works from the production managers' annual cost reports for existing works and from design data for the new works.

Indirect Operating Costs for the whole sewage business were available from the Activity Cost Table of NWL's Regulatory Accounts. Rules were developed to allocate indirect costs to individual works. For example, customer services, scientific services, regulation and bad debt costs were allocated based on the ratio of works equivalent population to total sewerage service equivalent population.

Capital Maintenance costs were assessed in two parts:-

- Infrastructure Renewals Expenditure (IRE) for the underground sewerage assets. Historical cost data (5 year average) were available for the sewerage network associated with each works;

- Current Cost Depreciation (CCD) for the above ground wastewater treatment works assets. CCD data were available for all existing works, broken down by treatment stage and asset type. CCD costs for the new works were derived from the design capital costs and asset lives.

Return on Capital was calculated by allocating a portion of the Regulatory Capital Value (RCV), for the whole sewerage service, to each works and its associated sewerage network. The RCV is a key measure used by Ofwat in valuing he capital invested in the business from privatisation onwards. The RCV allocations were based on Modern Equivalent Asset (MEA) values and population equivalents.

3.3 Analysis of Cost by Treatment Stage

At this stage all the different categories of costs had been allocated to each of the 17 sample works and their sewer networks. For each works the costs were then allocated to :-

- R (sewerage);
- V (preliminary and primary);
- B (secondary and tertiary);
- S (treatment of primary sludge).

The main cost drivers for each treatment stage were considered, i.e. what characteristic of the effluent has the greatest influence on the overall costs.

Initially, the main cost drivers were identified as flow for sewerage and preliminary and primary treatment costs, organic load for secondary treatment costs and suspended solids for the treatment of primary sludge costs. The modelling of secondary treatment costs was refined to split them into those driven by organic load (B) and those driven by flow (B_v).

The final step was to identify how much of these costs should be attributed specifically to trade effluent. For example, the ratio of trade effluent organic load to total incoming organic load was used to determine how much of the secondary treatment costs should be allocated to trade effluent at each works.

4. The Impact on Tariffs

For each of the 17 selected wastewater treatment works, the model calculated the cost of trade effluent treatment. The costs were broken down by treatment stage and by cost type. From these detailed costs, the model calculated weighted regional average costs for R (p/m^3), V (p/m^3), B_v (p/m^3), B (p/kg COD) and S (p/kg solids).

This analysis clearly demonstrated that the existing trade effluent tariff would not be cost-reflective after the introduction of secondary treatment at the coastal works in 2001. The modelling results were used to make the case of Ofwat for a change in both the structure and level of the trade effluent tariff. Ofwat approved Northumbrian Water's proposals and the amended Modgen formula was introduced in April 2001.

Table 1 – Northumbrian Water Trade Effluent Tariffs

	R**(p/m^3)**	V**(p/m^3)**	B_v**(p/m^3)**	B(p/kg COD)	S(p/kg solids)
2000-01	18.66	9.15	-	33.20	37.72
2001-02	17.83	8.72	4.84	18.93	35.57

Before the introduction of the 2001-02 tariff, further modelling work was undertaken to assess the impact on every trade effluent customer. Whilst most customers receiving secondary treatment for the first time were obviously faced with a significant increase in charges, the cost modelling work undertaken and the resulting tariff generally reduced the size of those increases and ensured cost reflectivity. For those customers (the minority) already receiving secondary treatment, the proposed tariff generally either reduced bills or was cost neutral.

Table 2 – Sample Trade Effluent Bills

	2000-01 (£/year)	2001-02 (£/year)	% change
5000m^3 low strength[1]	2288	2292	0
5000m^3 high strength[2]	7427	5714	-23

Note 1 : Low strength is 200mg/l COD, 300 mg/l SS
Note 2 : High strength is 2500mg/l COD, 1000 mg/l SS

5. Benefits of Modelling Sewerage Costs

The major benefit of this work to Northumbrian Water was that it demonstrated and quantified the direct relationship between the costs incurred by the business and the specific services provided to individual customers. Understanding the relationship between costs and the services or products delivered to customers is invaluable information for any business.

Cost modelling enabled Northumbrian Water to introduce new tariffs following a step change in their sewerage business; confident that these tariffs would reflect the actual cost of providing trade effluent services. The principles and methodologies developed for this work have subsequently been used to assess a range of other business issues, including:-

- Alternatives to Rateable Value based tariffs for dealing with surface water runoff;
- Receiving industrial effluents by tanker;
- Assessing the case for a specific tariff for ammonia removal;
- Assessing the cost of excess fats loadings and options for cost recovery;
- Modelling the cost of sludge transport to and treatment in the Regional Sludge Treatment Centre.