

# "SMALL COMMUNITY WASTEWATER TREATMENT PLANTS - GOOD NEIGHBOURS?"

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## ABSTRACT

Between 1999 and 2001, eight case study investigations were carried out on the host community experience of small to medium-sized wastewater treatment plant operations. The research programme aims to assist the processes of urban and rural planning by developing a body of knowledge on social factors that are relevant to the siting and operation of wastewater facilities. Findings will be presented on host community experience including the nature of off-site effects, the social impacts of these effects, and the relationships between those involved in wastewater treatment plant operation and their neighbours. Implications for consent monitoring are explored, as are the implications for the practice of impact assessment during RMA planning processes.

## KEYWORDS

**community experience, social impacts, community liaison, social monitoring**

## 1. INTRODUCTION

Eight case studies were undertaken as part of this social research programme (see figure 1). They were selected to provide a range of relatively recent facilities. Because of the requirement to avoid facilities involved in active resource consent proceedings or undergoing construction activities, most of the main metropolitan WWTPs could not be included in the case study work<sup>i</sup> at the present time. As a result, the sample comprises mainly relatively small-to-medium capacity facilities. However, it does include a variety of technology types and effluent disposal media<sup>ii</sup>. This makes the research particularly relevant to the increasing numbers of smaller communities which are being required to develop or upgrade reticulated sewerage systems. Until recently, many small communities in New Zealand have operated with individual septic tank facilities for each household, a practice that is becoming increasingly unacceptable on either environmental or cost grounds.

Care was taken in the social assessment research method to provide accurate and useful descriptions of the effects experienced by host communities, by canvassing a wide range of local observations, by accessing other relevant data sources where possible to corroborate the observations of neighbours, and by engaging in a process of feeding back preliminary findings for checking and validation by the research participants. As a result, the experience documented in these case studies should neither overstate nor understate the experience of the host communities involved. This is important, if the research is to assist participants in future planning.

## 2. DISCUSSION

It was evident from the previous stage of this research (Taylor Baines, 1999) that the case studies would be carried out against the backdrop of a progressive and significant rise in community expectations. As recently as twenty years ago, many communities in New Zealand were still discharging raw sewage into the environment. Because the effects of such practices were very evident there came a point for many communities when continuing this method of sewage disposal became both culturally and politically untenable.

Such rising expectations were manifest in a variety of ways. Even for relatively small community sewage treatment schemes in the size range represented in this sample of case studies, higher standards for the treated effluent require technical designs which often now include tertiary levels of treatment<sup>iii</sup> where previously primary treatment was the norm. Other signals of the rising expectations are found in requirements for stricter

monitoring regimes regarding effluent quality, in the general trend away from direct discharge of effluent to surface waters, particularly for smaller-scale treatment plants<sup>iv</sup>, and in the sometimes very restrictive consent conditions increasingly being specified for the control of odour and other airborne nuisances in sewage treatment and disposal operations. This is the backdrop against which the case study experiences investigated in this research programme were carried out.

The findings are discussed under three themes. Firstly, the overall experience of the eight host communities is summarised. Secondly, insights into the relationships between major stakeholders are reviewed, with particular emphasis on learning lessons relevant to the future planning and management of similar facilities. Thirdly, the practice of impact assessment, as manifest in the Assessments of Environmental Effects for these case studies is evaluated.

## **2.1 COMMUNITY EXPERIENCE**

Community experience is summarised under sub-headings:-

- the incidence of off-site effects - ‘crossing the boundary’,
- factors influencing the degree of impact and individual sensitivity - ‘the community setting’,
- new sewage treatment methods - ‘the technology’,
- odour problems, and
- water quality issues.

### **2.1.1 CROSSING THE BOUNDARY**

In the eight case studies carried out, all the host communities had experienced some significant off-site effects and impacts at some time. In several cases, there had been up to three types of effect experienced. However, in half the cases, the levels of impact remaining after several year’s operation could be described as ‘no more than minor’.

Unpleasant odour beyond the boundary was the most common off-site effect (significant and on-going in five cases). However, not all WWTPs created odour problems for immediate neighbours.

There were some unexpected effects which had not been considered in any of the impact assessment studies (see more of this later in the section on effects assessment). There were also instances of beneficial effects - apart from the intended benefits<sup>v</sup>. These were generally the result of positive landscape, recreational amenity and wildlife habitat changes associated with new wetlands.

Thus the experience of significant effects beyond the WWTP boundary is a common experience for host communities. In most cases, the off-site effects were amenable to mitigation with relatively minor changes, investments and costs. However this was not invariably so. In one case, major capital investment was necessary to provide an alternative method for handling and disposing of sludge, while in another case major capital investment will be required to address plant overloading problems (treatment capacity constraints). In three out of eight cases, normal day-to-day patterns of operation had become established which were generally acceptable to immediate neighbours.

### **2.1.2 THE COMMUNITY SETTING**

The mix of cases in the sample revealed that host community sensitivities appear to depend to some extent on the setting; whether they be rural, rural-residential, industrial, or in a predominantly recreational area. The table below indicates differences in apparent sensitivities between various community settings, based on the sample of eight case studies.

*Table 1 'Priority' issues or sensitivities - by community setting*

<b>Community setting</b>	<b>Apparent sensitivities</b>
Rural	weed control, spray drift, surface water contamination
Rural-residential	odour, visual, noise, traffic
Industrial	odour, visual
Recreational	surface water contamination, landscape amenity, litter

The main point here is that setting may influence susceptibility to different effects. This is not to imply that setting determines susceptibility. It would be wrong to conclude from the above table, for example, that the risk of unpleasant off-site odours will never be an issue for recreational activity in the vicinity of a wastewater treatment plant. However, occasional visitors making transient use of an area may be less vulnerable to odour problems than to water quality or litter problems.

The case study research reinforced that different people have different thresholds when it comes to noticing effects. These are related to their ability to detect smell, and to hear, and so on. The personal experience of individuals may also be related to different living patterns. For example, some people are on their property all day, every day, while others are working off the property during the week. However, rural or industrial settings may have other activities in close proximity which may influence the local benchmark for impact. For example, the established and accepted presence of pig farms, chicken farms or mushroom factories in a rural area is likely to influence people's response to odours from a WWTP. Similarly, proximity to other sources of 24-hour industrial noise or high traffic volumes will influence people's response to any noise effects emanating from a WWTP.

An issue that arose in the one industrial case study concerns whether or not there is any difference between workplace amenity expectations and residential amenity expectations. Is there any basis on which to treat amenity standards (odour, noise, visual effects) in workplaces any differently from amenity standards in private residential property or public space? The Resource Management Act does not discriminate on these grounds.

### **2.1.3 THE TECHNOLOGY**

The rise in community expectations alluded to earlier has had particular ramifications for small and medium-sized communities. Whereas the trend in solid waste management has been towards increased regionalisation of disposal facilities (Taylor Baines, 2001), the constraints of reticulation have meant that increasing numbers of smaller communities around the country have had to invest in their own wastewater treatment and disposal facilities over the past decade in order to meet environmental objectives. Many new facilities have been constructed and commissioned - four of the eight case studies fall into this category. Each of these cases exhibited a settling down period, during which it took time to establish normal operations and during which some off-site effects were more noticeable than they have subsequently become. Two have settled into acceptable operating regimes, while two others still have operating problems unresolved even after several years of operation. The research interviews revealed a higher level of tolerance amongst neighbours for these 'settling down' impacts than for impacts associated with supposedly 'normal' operating patterns, which result in persistent nuisances.

Some cases also involved the adoption of relatively new technology, sometimes without much experience elsewhere in New Zealand<sup>vi</sup>. Land disposal and wetlands are still relatively recent innovations for the wastewater industry in this country.

### **2.1.4 ODOUR PROBLEMS**

Even though the incidence of unpleasant odours beyond the boundary was the most common off-site effect encountered in these eight case studies, the sample also revealed that such odour problems are not always experienced. Good standards of operation are achieved in practice. When odour problems do occur, distance matters, and to a lesser extent predominant wind direction and occupancy patterns. In five of the eight cases, the spatial extent of intrusive odours reached between 200m and 600m from the WWTP boundary. In two cases

(larger plants in the sample, situated in or near estuaries) the spatial extent may have stretched as far as 2km. In three of the cases, chronic odour problems were associated with sludge handling and disposal.

### **2.1.5 WATER QUALITY ISSUES**

Water quality issues are always a key concern in the minds of the general public, in planning and operating sewage treatment plants. However, the effects of discharging treated effluent into a moving body of water are not always easy to discern with the naked eye, and therefore not easily detected by human observation. In some cases, the potential sources of effects and impacts - elevated nutrient levels, the presence of pathogens and other bacteriological species - are invisible. Only the gross aspects of liquid discharge - bubbles, surface scums, suspended solids and discolouration would be evident. Nevertheless, people have perceptions based on observing various phenomena, and there is no doubt that perceptions alone can alter people's behaviour patterns, thereby leading to impacts.

As noted above, there are limitations to the information provided by lay observations of water quality effects from effluent discharge. Another factor that always has to be borne in mind is that the WWTP was usually put in place for the express purpose of discontinuing previous practices of discharging untreated (or barely treated) sewage or other wastewater streams. The main impact is therefore a major, but once-only, step change in the quality of effluent and therefore in the nature of water quality impacts on the receiving environment. As ambient water conditions improve, remaining discharges can sometimes seem more offensive in a subjective way, even if people's behaviour might suggest otherwise. The question that often arises concerns what the appropriate benchmarks for water quality comparisons should be. For example, water-based recreational activity may increase markedly with the introduction of a new WWTP with a relatively high quality effluent, compared to previous discharges. Close attention to the quality of this effluent discharge might suggest that (in absolute terms) it still poses certain risks to human health or other species within a specified mixing zone. When viewed in the wider picture however, it may be that sewage effluent is no longer the main factor affecting ambient water quality - and therefore determining people's use of the water environment.

## **2.2 RELATIONSHIPS**

This section reviews the relationships between major stakeholders (in the operation of WWTPs) with particular emphasis on learning lessons from the case study research that might be relevant to the future planning and management of similar facilities. Three questions are used to give structure to the discussion:-

- who are the principal stakeholders?
- how do these parties relate at the present time?
- is there a missing link?

### **2.2.1 WHO ARE THE PRINCIPAL STAKEHOLDERS?**

As noted above, the experience of significant effects beyond the WWTP boundary is a common experience for host communities. In the management of WWTPs and their off-site effects, some parties have statutory responsibilities while others have a more direct interest in the outcomes of WWTP operation.

In New Zealand, all WWTPs are planned and administered by Territorial Local Authorities (TLAs), even if they contract out the operation and even ownership of the facilities to others. In the sample of eight cases, all the WWTPs are owned by the TLA concerned. However, with one exception, the facilities are operated under term contracts by private contractors (usually SOEs or LATEs or some derivative of these). The TLA remains accountable to the community for the achievement of satisfactory operational standards. The TLA is also responsible for the land-use consent

Private contractors provide the operating skills and staff. In six out of eight cases, staff are not present full time at the WWTP. In two of the smaller cases, staff attend the plants only two or three days each week. Automation and computer-controlled communications mean that operating staff can be summoned at short notice in cases of malfunction.

Regional councils have statutory responsibilities to administer the resource consents associated with discharges to water and air.

Members of the host communities - neighbours, users of the receiving environments - are those who share a common environment with the WWTP.

## 2.2.2 HOW DO THESE PARTIES RELATE AT THE PRESENT TIME?

Members of the host community will invariably be ratepayers to both TLA and regional council. However, in five out of the eight cases, the immediate rural residential neighbours of the WWTPs are not connected to the sewage reticulation network and therefore do not receive the service benefits from the facility. This is not an uncommon situation for small and medium-size schemes built during the last decade in New Zealand.

Arrangements are largely reactive. If neighbours have reason to complain about the operation of a WWTP there are likely to be complaints procedures for both the TLA and regional council concerned. It is just as likely that these complaints procedures will not be well known or well understood by most members of the host community, nor will they be perceived as being responsive.

Using odour complaints as an example - also odour is the effect most likely to provoke a neighbour's complaint - the research provides the following information, pooled from all eight case studies. Of the 664 individual interviews conducted, 41% recorded odour effects, and 20% recorded impacts above 'level 2' - in other words the impacts reported by these 20% of respondents ranged from a loss of personal residential amenity to social discomfort to risks to health or personal well-being. However, the proportion of all interviewees who had ever complained about odour was 12%. Most case studies disaggregated the interviews spatially between 'near' and 'far'. The corresponding proportions for the 'near' interviewees are summarised in the following table:-

*Table 2 Percentages indicative of a willingness to complain about odour*

<b>Category of response</b>	<b>All interviewees N=664</b>	<b>'Near' interviewees N=234</b>
Those who reported odour effects	41%	64%
Those who reported odour impacts > level 2	20%	36%
Those who complained about odour	12%	23%

At most, two out of the eight TLAs in the case study sample maintained computer-based records of complaints. Feedback discussions about the case study findings with operators and administrators suggest that the assessments of effects and impacts by members of the host communities are not exaggerated. However, the same discussions tended also to expose attitudes that *'if there are no complaints, there can't be any problems'*.

Little use is made of neighbourhood liaison groups in this sample. In fact, in only one case study did such a group exist, and it had been established as a requirement of a more recent resource consent after an abatement notice had been served on the WWTP operator. This shows slightly different experience from that revealed by the landfill research, in which three out of seven cases involved neighbourhood liaison groups - one established during the initial planning stage consultation activities and the other two established as requirements on resource consents.

Discussions between the researchers and the plant operators generally revealed a preference amongst plant operators for direct contacts with their host communities. Similarly, feedback discussions with host community residents revealed considerable interest in direct dialogue with operators. However, the operators generally are not authorised or set up to do this. Nevertheless, the wastewater industry has expressed interest in fostering closer links between operators and their host communities within the framework of a 'code of practice'.

What seems clear is that, for all practical intents and purposes, regional councils are often too remote for effective surveillance or response on a day-to-day basis, particularly in relation to off-site odour effects. Indeed, the same could be said for the situation of Environmental Health Officers with some of the TLAs. In some cases, TLAs automatically deferred to their regional councils over odour issues.

### 2.2.3 IS THERE A MISSING LINK?

The research suggests that the answer to this question is 'Yes' - between the most direct stakeholders - those who operate the plants and those who live or work nearby.

It might well be asked in what context the question is relevant. The case studies suggest two contexts. Firstly, from a fundamental as well as practical viewpoint, the RMA planning context, with its emphasis on effects-based assessments, is aimed at ensuring that the permitted operations of such facilities do not cause unacceptable impacts to anyone else - and immediate neighbours are amongst the most likely to experience off-site effects if anyone is going to. The effects-based approach is based on the fundamental premise that, so long as an activity causes no more than minor effects to other parties (including immediate neighbours), it may be granted resource consents to proceed. Thus, whether or not the effects experienced by immediate neighbours are minor or significant is a critical question. The corollary to this is that, if there are problems at a WWTP resulting in off-site effects, the immediate neighbours are most likely to experience them and also to be able to notice whether on-site changes by operations staff make any difference or not. Direct contacts between operators and neighbours are likely to be the most efficient means for diagnosing off-site problems and testing the effectiveness of remedies. Operators need information from neighbours. The RMA approach to planning makes consideration of the effects on neighbours a central issue.

The second context concerns accountability to consent conditions. Consent conditions embody protections for neighbours. In granting resource consents, there is a presumption that consent conditions will prevail. In the case of WWTPs, consent conditions usually apply to the discharge of liquid effluent - to land, river, estuary, ocean - and to discharges of contaminants to air resulting from treatment and disposal operations. Odour and aerosols could arise in a variety of situations - ponds with mechanical aerators, spray irrigators for liquid effluent, handling of sewage screenings or treatment and disposal of sewage sludge. Consent conditions may also apply to such things as the requirement for screen planting to address visual impacts.

Discharges of liquid effluent attract conditions associated with the biochemical quality of the effluent - not amenable to casual observation - as well as conditions that may well be observable by lay people - the timing of discharges, the ponding during periods of heavy rainfall, and so on. Effluent quality is indeed a characteristic best tested under laboratory conditions. However, if effluent discharge to an estuary is constrained to occur on out-going tides, neighbours may well be able to distinguish compliance from non-compliance, even if they cannot detect effluent quality. Similarly, if land irrigation of effluent using aerial sprays is constrained not to occur above a certain wind speed - to avoid aerosol drift across the property boundary - then neighbours may well be able to distinguish compliance from non-compliance, even if they cannot detect effluent quality.

Odour effects and impacts, on the other hand, are predominantly subjective, and not so amenable to quantitative discrimination. Hence consent conditions on odour control tend to rely on distinguishing the presence or absence of offensive odours. They may also sometimes prescribe a format and procedure for the recording of complaints.

In one case out of eight, regional council consent staff adopted a numerical scale for characterising the intensity of odour effect when summoned by a complaint. Complaints records showed that calibration of the numerical scale remained problematic<sup>vii</sup>. Neighbours, however, were able to describe the nature of an odour problem in terms of the frequency with which it occurs, its duration, and the nature of the resulting impacts. In three of the eight cases - all involving persistent off-site odour problems, TLAs acknowledged temporary or informal use of neighbours' observations and records. In no cases was there any systematic or on-going arrangement made for soliciting information from neighbours.

Another consideration to bear in mind is that consent conditions will only be specified for effects that have been anticipated during the planning stage. If an effect was not anticipated - as in the case of weed spread from effluent disposal land, or the case of wave-induced and windblown litter from oxidation ponds - there will be no management condition attached to the consent to address this subsequent effect. For effects whose character is essentially subjective, the neighbours' perspective is central to any evaluation of consent compliance. It is also likely to be necessary for the reporting of effects which have not been anticipated.

The eight case studies in this research programme demonstrate that most WWTPs are operated in ways which do not comply strictly with their consent conditions. The amenity values of neighbouring properties - whether they

be residential, recreational or industrial space - are compromised from time to time in a manner not expected by the terms of the resource consent conditions. There are also unanticipated effects which have occurred from time to time. This is the reality for members of most host communities.

The research does not suggest that most WWTPs are operated very poorly; merely that strictly speaking they do not generally meet the standards expected of them when they were granted consents to proceed. The issue then becomes a question of what is realistic in terms of compliance? What is desirable, and from whose point of view? How is performance to be monitored for effects not easily amenable to analytical measurement?

This research suggests two possible mechanisms - the use of neighbourhood liaison groups and the use of periodic social monitoring. Neighbourhood liaison groups involve establishing, with a degree of formality, a link between WWTP operators (consent holders) and immediate neighbours. Their primary function is to assist plant operators to achieve standards that are indeed acceptable and supported by their host communities. Social monitoring establishes a link between the consent granting authority and immediate neighbours on a periodic basis, to overcome the difficulty posed by the consent granting authority not having a regular on-site presence.

However, we need to recognise why such mechanisms are not widely adopted at the present time. Community liaison groups are something of an unknown quantity. There is little knowledge of how to set them up, how they should operate, and what expectations people have of them. Furthermore, their prospect raises prickly notions of shifting control and authority, or conversely, of time-wasting effort with little to show for it. Where is the incentive to establish neighbourhood liaison groups? Who has the obligation to take the initiative? Similarly, the concept of 'social monitoring' probably carries with it the connotation of expensive and time-consuming social surveys; hardly an attractive proposition to those in public office constantly grappling with many calls on rating revenue and the ever-present pressure to restrain rates increases. In fact, the wider research programme suggests that possible answers to these questions exist by way of example.

## **2.3 THE PRACTICE OF IMPACT ASSESSMENT**

Projected effects from impact assessments during the planning and resource consent process were compared with actual effects reported during the research case studies. The comparisons, where possible, are at two levels. Firstly, lists of projected effects are compared with lists of reported effects to see if there was an accurate mapping of the types of effects to be expected. Secondly, the actual outcomes experienced by host communities for each effect are compared with the judgements made during the ex-ante assessments.

### **2.3.1 AN ACCURATE OF MAPPING EFFECTS?**

This can be looked at in two ways. Firstly, in five out of eight cases, effects were projected which no neighbours subsequently reported in actual practice. Sometimes these were effects which would not normally be observed by untrained eyes or casual, visual observation - effects such as groundwater contamination and seepage, and generalised 'effects on ecosystems'. Sometimes however they were effects that are definitely amenable to casual observation - spray drift, noise, visual impacts, and impacts on food gathering. And sometimes they were effects that might simply not have occurred during the time frame of the case study evaluation - effects such as flood-related risks and risks from other natural hazards. Thus, the fact that local observations did not always corroborate prior expert assessment is not necessarily an indictment of that assessment.

Secondly, in six out of eight cases, effects were reported which had not been projected previously. Clearly, social monitoring picked up these effects - such as the presence of increased numbers of insects near wetlands, the spread of noxious weeds, construction nuisances, increased traffic volumes and noise from mechanical equipment. This is an aspect of impact assessment - the capacity to make accurate projections - which should be assisted by the knowledge gained in these case studies.

### **2.3.2 ACCURATE PREDICTIONS OF OUTCOMES?**

Overall, there are not many cases where questionable or wrong assessments were identified. In three cases, the projections about odour were clearly wrong when judged by the experience of neighbours. This probably reflects the difference in perspectives - a technical perspective, assuming that proposed plants will generally be working well and as intended, versus the social perspective, based on actual experience. In two cases, the projections about visual impacts were incorrect.

These (ex-post) case studies can provide an empirical basis on which to improve future ex-ante assessments by providing some practical insights. They also highlight the importance of following through on proposed mitigation measures.

### **3. CONCLUSIONS**

Experience suggests that all WWTPs and their host communities would benefit from implementing some form of direct liaison between plant operators and immediate neighbours, and from the periodic use of social monitoring. There is still much to learn about these practices. The combination of pro-active liaison and periodic social monitoring has the potential to contribute to more effective plant management, monitoring and evaluation. It also helps to build a more positive set of relationships by enabling meaningful participation on the part of individuals in the host community. Furthermore, the waste water industry has expressed interest in exploring and encouraging such development - which should be positive when put alongside the interest and enthusiasm encountered in many of the case studies.

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- i. Auckland, Hamilton, Rotorua, Christchurch and Dunedin were excluded on these grounds.
- ii. Six WWTPs were on rural land; one surrounded by an estuary and one adjacent to an industrial worksite. Five cases made use of ponds/lagoons, four used activated sludge treatments, three employed wetlands as part of the treatment system, and two used land irrigation. Effluent discharge for three cases was to a wetlands/river-creek/estuary combination, for two cases into an estuary or harbour, while two cases involved land treatment and disposal and one used direct discharge to creek.
- iii. Physical screening, biological treatment and significant reductions in pathogen levels with UV treatment and/or land disposal.
- iv. The increased use of wetlands and land treatment/disposal options is well represented in the case studies summarised.
- v. Such as the intended benefits of reduced contamination of receiving waters, and removing constraints on further residential development or intensification in non-reticulated rural areas.
- vi. The adoption of Autothermal Thermophilic Aerobic Digestion (ATAD) units for sludge treatment in one of the case studies remains a first for the country even today. Similarly, another case study involved one of the first applications of biological nutrient removal.
- vii. There was no systematic explanation of why officers' estimates on the odour intensity scale were sometimes greater than and sometimes less than the corresponding estimates of the complainants.

Figure 1: Location of 8 case studies.

