"From Past to Future: siting waste facilities in New Zealand"

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Abstract submitted

"This publicly-funded research project asks two central questions. Firstly, is there, from a social perspective, a systematic pattern to the siting of waste water facilities in New Zealand? Secondly, if so, how would this pattern be characterised from the perspective of the host communities involved? The research covers 27 siting decisions in 17 Local Authority areas over the past twenty-five years. The sample of siting decisions covers a range of community size (metropolitan to very small), a range of disposal environments (ocean, harbour/estuary, river, wetland, land) and the transition from the Town and Country Planning Act to the Resource Management Act. Demographic analysis of waste source communities and facilities' host communities examine source-host comparisons on the basis of education, ethnicity, occupation and employment status, life stage, dwelling tenure and household income. A comparison of the selected host communities with the alternative candidate host communities (i.e. alternative sites) is also made. These analyses investigate whether or not there are any indications of systematic bias against socio-economically disadvantaged communities. The implications of these findings for the planning and decision-making process are discussed. On-going research is outlined."

1 Introduction

The theme "From Past to Future" captures several dimensions of the context for this research. For the research team, the idea for the research programme had its genesis in a the planning activities linked to the selection of a series of sites for waste facilities. As a hermeneutic exercise, planning processes should embody the notion of learning from past experience and applying these lessons to new endeavours and future decisions.

Secondly, there is abundant evidence that community values vis-a-vis the natural environment and the importance of maintaining higher environmental quality have changed significantly in recent

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times. As recently as twenty years ago, many settlements in New Zealand were still discharging raw sewage into the receiving environment, whether it be river, estuary or sea. Similarly, the once familiar practice of siting landfills on the margins of rivers - perhaps hidden from sight by the willows - or estuaries is now far less common, reflecting a heightened degree of public abhorrence of such gratuitous water contamination. Universally, much higher standards of environmental protection are expected in the future.

The third dimension of change has been the advent of new technologies[2] and new planning institutions[3].

But research is about systematic enquiry, and public good research is about using the results of such enquiry to inform the public and decision makers. This research - on site selection decisions and on the actual effects of these facilities as experienced by their host communities - contributes to a broader process of societal learning. It is aimed at promoting better planning in future, by exposing some of the myths that have arisen out of past practices.

Since submitting the abstract for this paper, other research results have become available, which add diversity to the pool of empirical data. Consequently, the content of this paper has been expanded to cover experience of siting decisions for both solid waste and waste water facilities. Both areas of enquiry employed the same research methods, so expanding the coverage of the paper seemed appropriate for the benefit of conference participants.

2 Hypothesis

Anyone who has ever been involved in the site selection process[4] for a new landfill or waste water treatment plant, will be familiar with the challenges to the planning process - *"Why do we have to have everyone else's rubbish here?"; "What's it really going to be like?"; "If it's so squeaky clean, why don't you put this dump in the mayor's suburb?"* The planning situations bring to the surface genuine concerns about two related issues - environmental justice and the credibility of effects assessments.

In the US, the environmental justice movement which began in the early 1980s, has been defined by the socio-political organization of grass-root and national groups that challenge inadequate environmental regulations and industrial practices that put at risk communities and neighbourhoods

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2 Sanitary landfills and transfer stations have replaced the open tips of the past, not to mention the greater interest in waste reduction, recycling and municipal composting. Land treatment and disposal of waste water effluent and the use of wetlands are no longer viewed as such radical technical options.

3 The re-organisation of local government in 1989 and the passage of the Resource Management Act (1991) came almost in the middle of the period of site selection decisions examined in these research programmes.

4 Either as a professional involved in the assessment of potential effects or the technical aspects of planning or design, or as a member of a prospective host community, or as someone from the Territorial Local Authority, or as a decision maker.

with disproportionately large poor and minority populations. Referring to hazardous waste sites, Bullard (1994) reports that a national study of uncontrolled hazardous waste sites and commercial hazardous waste landfills "concluded that race was the single most important variable associated with the location of these sites." There has been no similar analysis of the social dynamics of the siting process in New Zealand.

One of the principal objectives of the research programmes described in this paper was to test the hypothesis that social or demographic factors will be evident in the siting of waste management facilities in this country.

3 New Zealand empirical data

Underpinning the research objective just described is the importance attached to assembling empirical data for New Zealand. For too long, planning waste management activities in this country has been informed by overseas experience, research and data. While it may often have been argued that it was better to use empirical research from elsewhere to support effects assessments and planning activities, rather than ignore empirical evidence completely, this hardly constitutes an argument to continue this less-than-satisfactory approach.

Any expectations that the introduction of the Resource Management Act might lead to more effort in monitoring real life experience of waste facilities have generally met with disappointment. Territorial Local Authorities have often found the resourcing of environmental monitoring activities a particularly burdensome responsibility. As a result, monitoring and evaluation tend to be minimal in scope, usually driven by narrow considerations of consent monitoring[5]. There is generally no effort going into social monitoring, or the use of social research as part of monitoring and evaluation exercises for waste facilities[6]. Indeed, many waste facilities have no formal liaison mechanism with host community representatives, and some Local Authorities do not even maintain systematic records of community complaints. Consequently, the monitoring requirements of the Act have yet to generate a body of empirical experience from which operators, planners and resident communities can draw.

It is stating the obvious to say that reliance on overseas studies ignores any differences in social, cultural and environmental context. A little reflection quickly leads to the conclusion that no excuse can really be offered for continuing this state of ignorance, given the fact that so many towns and cities have had municipal waste facilities for decades, and even relatively new facilities in the past ten to fifteen years. The need for social research was even more pressing when it became evident how often anecdotal reference was creeping into planning proceedings - *" the people in ..... made enough noise about <u>their</u> site, it was dropped"* or *"we know what it's like at the ..... landfill!"* Hence

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5 Generally focussed on physical variables specified in consent conditions; sometimes including biological monitoring.

6 The research did encounter several recent cases where the operators of waste water treatment plants are engaging with host communities to co-operate in monitoring odour effects so that plant operations can be improved and the incidence of offensive odours reduced.

the willingness of the Foundation for Research, Science & Technology to fund these research programmes in full, and accord them the rankings of 'important' and 'timely' in their peer reviews.

The research programmes covered 27 landfills and 31 waste water treatment plants (WWTPs) for which site selection decisions were taken between 1976 and 1998. Selection criteria involved consideration of -

(i) a range of siting dates (i.e. both older and newer sites), with specific attention to spanning the transition in planning legislation from the Town & Country Planning Act (1977) to the Resource Management Act (1991),

(ii) a range of sizes (i.e. facilities serving metropolitan areas, medium-sized cities and towns, and smaller rural centres),

(iii) facilities which have been sited in totally rural settings and those within city and town boundaries,

(iv) cases where the choice included continued use of an existing facility/site and those where only new sites were considered,

(v) landfills with and without public access, and with varying design standards (i.e. with and without impermeable liners, etc.),

(vi) waste water treatment plants employing a range of disposal environments including ocean outfall, river or estuary discharge, wetlands treatment, and land disposal.

There were also some more practical considerations. In order to make the research budget stretch as far as possible, the team looked at regional clusters of sites, to minimise travel time. In the event, the most restrictive constraint turned out to be the availability of demographic statistics[7] which were obtained for 1981 onwards, from the 5-yearly censuses. Another constraint, less universal than access to statistics, though no less important to the research, is the loss of institutional memory in the Territorial Local Authorities (TLAs). Sometimes several cycles of re-organisation, with the associated loss of personnel, mean that no-one remains in the present organisation who remembers the planning processes for site selection. In some cases, the documentary records do not exist either[8].

The research thus encompasses a good proportion of recent site selection decisions in New Zealand, representing the full cross-section of urban scale and spanning decades either side of major institutional change.

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7 It was not possible to access mesh-block data from censuses prior to 1976. Furthermore, the cost of retrieving mesh-block data from the 1976 census proved prohibitive, given the research budget allocation. Demographic statistics were obtained for the following census years - 1981, 1986, 1991, 1996.

8 Sometimes, personnel simply do not know where to look for the documentary material; in some cases it has been discarded or lost; in one case, the materials were lost in a fire.

4 Methodology

The research employs the concepts of *'source community'* and *'host community'*.

The term *'source community'* refers to the population resident in the geographic area that is serviced by the planned waste facility. This differs between solid waste and waste water, for the simple reason that waste water is pumped and piped from its source to the waste facility whereas solid waste is usually transported by road from its source to the waste facility. In the case of solid waste, the source community implies the entire population resident in the geographic area covered by the TLA which has responsibility for deciding the location of the solid waste facility, incorporating all those who generate solid waste which requires either handling in a transfer station and/or disposal at a landfill (see Figure 1). In the case of waste water, municipal sewerage systems are defined by the contiguous piping network which connects every contributing household as a source of sewage. Not infrequently, there are settlements in which not every dwelling is connected to the reticulation network. This is particularly true for smaller rural towns and for the rural fringes of larger centres. Thus most rural areas are not included in the source community for waste water treatment facilities (see Figure 2).

The term *'host community'* is used to refer to the community resident in the geographic area most clearly associated with a particular waste facility. It is not limited only to those residents who may experience direct physical effects from the operation of such a facility (such as the effects of noise, litter, or odour). It extends to include members of a coherent community - perceived in a social sense - that already exists at the time the facility siting decision was taken, and which will continue to develop in ways that may or may not be affected by the presence of the solid waste facility in its locality.

Having defined the concepts, the research set out to establish whether or not, from a social perspective, there are significant differences between source and host communities. In looking for appropriate indicators for this research, attention was focussed on socio-economic variables that could be considered to correlate with 'less powerful' groups in the community - 'power' as in the ability to understand, take part in, or in any way influence the kind of decisions which lead to the siting of public utilities, which are usually subject to adverse expectations.

Figure 1: Relating the concept of 'host community' and 'source community' - Landfills.

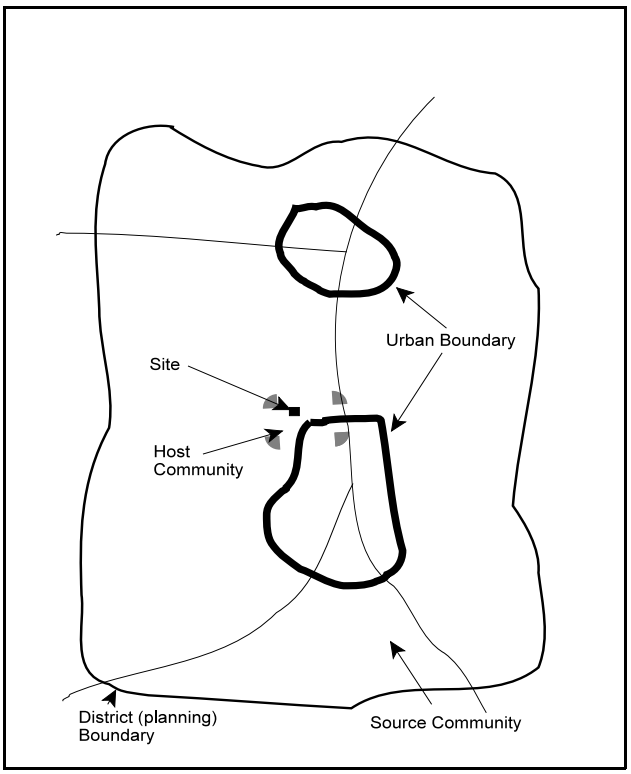
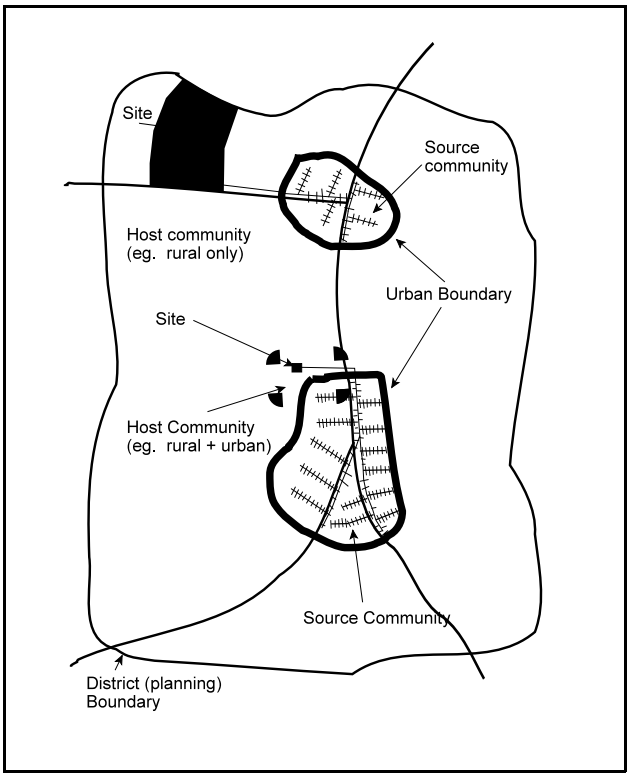


Figure 2 Relating the concept of 'host community' and 'source community' - WWTPs.



The seven variables selected[9] were:

Educational qualifications	% of population aged 15 years and over with NO tertiary qualification
Ethnicity	% of the total population that is NON European
Occupational status	% of the population aged 15 years and over who are NOT legislators, administrators, professionals, technicians
Employment status	% of the population aged 15 years and over who are NOT employed
Life stage	% of households with at least one child under 5 years old
Household tenure	% of private dwellings that are NOT owned by the occupant
Income	median household income[10]

9 Based on the 'usually resident' population in the host and source communities. Fuller explanation is provided in Taylor Baines (April 1999) Appendix I.

10 This variable could not be subject to the same kind of significance testing as the others, being a median value rather than a bi-modal percentage value.

Host communities were compared with source communities[11] by examining the ratio between 'observed' and 'expected' values[12] for each demographic variable and for each site. The comparison was subject to two levels of testing.

Firstly, each individual comparison - host community with source community for each demographic indicator - was subject to a significance test based on the chi-square measure, where each value is compared to the chi-square distribution with one degree of freedom. In other words, if the host community in one locality is different from its source community, in terms of having say a higher proportion of non-professional workers or a higher proportion of people not owning the dwelling they live in, then how strong is the evidence for the difference? This analysis focuses on each individual locality and siting decision.

Secondly, the statistics were pooled[13] for each variable over all sites to assess whether there is any indication of systematic bias in the demographic characteristics of selected sites. In other words, if the pooled statistics describing say the proportion of non-European residents or the proportion of unemployed residents for all the host communities appears different from the corresponding statistics for all source communities, then how strong is the statistical evidence for this difference?

The research focusses primarily on the second level of analysis to assess whether there is any evidence of systematic bias. However, the individual comparisons allow some analysis of trends over time.

The host communities at selected sites were also compared with 'alternative host communities' - those which would have been host communities had alternative sites been selected from the short list in each case.

To interpret the results presented in the tables that follow, the reader should note (a) that a ratio greater than Unity (>1) indicates 'relative disadvantage' between host and source communities (i.e. the host community has a greater proportion of 'less powerful' residents than the source community) and a ratio less than Unity (<1) indicates that the host community was not disadvantaged in this regard; and (b) a Chi-square value greater than 3.84 is normally taken to indicate a statistically significant result. However, given that we are dealing with census data, large Chi-square values are to be expected and the Chi-square values reported here should be interpreted as relative measures of strength of evidence, rather than strict indicators of "significance".

Background information on each site was gathered from a range of sources. Some was sourced from the 1995 Landfill Census database, commissioned by the Ministry for the Environment, and from

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11 Specified statistically as the non-host population

12 'Expected' values for a host community are derived by taking the corresponding value for the non-host community, assuming there were no difference between host and non-host values. Full details are provided in the methodological note in Taylor Baines (April 1999) Appendix II.

13 The pooled statistics are based on weighted averages of the site specific results, with weights reflecting the amount of statistical information provided by each site.

the National Database on WWTPs which is managed by Woodward Clyde on behalf of the NZ Water and Wastes Association (NZWWA). This background technical information was obtained prior to visiting the facility operators. These visits involved a structured interview (covering facility planning and decision making, and the operator's knowledge of the historical setting for the site), and inspection of the site itself and its neighbouring area aimed at specifying the boundaries of the host community. The structured interview material was compiled into a qualitative database for systematic analysis. Based on this fieldwork, the research team met to finalise the host community specifications so that the corresponding statistical areas could be mapped and the census data retrieved.

5 Results

Results are provided in tabular form. In each case, two sets of results are provided; firstly, the pooled results for comparing host communities with source communities; secondly, the pooled results for comparing selected host communities with alternative host communities.

Landfills:

Tables 1 and 2 give the results for 22 landfill sites, selected between 1977 and 1997, with 12 cases where alternative sites were also investigated. There is no consistent bias towards relative disadvantage in host communities. Three indicators suggest relative disadvantage (lack of education, non-professional occupations, dependents in the household) while three suggest relative advantage (high proportions of pakeha residents, high proportions in active employment, high proportion of property ownership). This grouping of demographic features is characteristic of rural populations, and is therefore consistent with the fact that landfill sites are most often located in peri-urban or rural areas.

Table 1: Pooled results for comparing landfill host communities with source communities (N=22)

	Education	Ethnicity	Occupation	Employment	Children	Tenure
Pooled Ratio values	1.02	0.96	1.06	0.91	1.33	0.84
Host-source relativity	disadv.	adv.	disadv.	adv.	disadv.	adv.
Chi-square	19.19	9.17	204.54	10.67	241.30	105.48

The differences between host and source community (as shown by the Pooled Ratio values) are typically not large, with the exception of the proportions of households with young children (relatively high in host communities) and the proportions of dwellings which are rented (relatively low in host communities).

Only descriptive analyses for the seventh variable - median household income - were undertaken since formal statistical analysis requires additional distributional information not provided routinely in census products. For the 22 sites, six host communities had lower median household incomes than their corresponding source communities, whereas 16 host communities had higher median household incomes. The average host/source community ratio for median household income over the whole sample is 1.08 (ranging from 0.73 to 1.47), indicating that host communities around landfill sites typically have not been lower-income communities than their corresponding source communities.

The absence of systematic bias towards relatively disadvantaged host communities in site selection described above is not repeated when host communities are compared with 'alternative host communities'. A pooled analysis for twelve cases was carried out, which reveals consistent bias towards relatively disadvantaged candidate host communities in the short-list situation, as shown in Table 2. The twelve cases include eight where decisions were made under the RMA.

Table 2: Pooled results for comparing selected host communities with alternative host communities (N=12)

	Education	Ethnicity	Occupation	Employment	Children	Tenure
Pooled R	1.06	1.72	1.08	1.59	1.46	1.24
Host-alternative host relativity	disadv.	disadv.	disadv.	disadv.	disadv.	disadv.
Chi-square	31.76	153.69	52.80	22.78	43.91	21.67

Not only is the pattern of relative disadvantage more uniform (when compared with Table 1), the differences between selected host and alternative host communities (as shown by the Pooled Ratio values) are sizeable in four out of the six variables.

The pattern of systematic bias is reinforced further in the comparison of median household incomes between selected and alternative host communities. In eight out of the twelve cases, the median household income level for the selected host community was lower than the alternative candidate host communities, and the average ratio of median household incomes is 0.94 (ranging from 0.60 to 1.45), indicating that selected host communities typically have been lower-income communities than those which were not selected from the shortlist.

Waste Water Treatment Plants:

Tables 3 and 4 give the results for 31 WWTP sites, selected between 1976 and 1998, with 12 cases where alternative sites were also investigated. The results suggest a consistent bias towards relative disadvantage in host communities, as shown in Table 3. Five out of six indicators suggest relative disadvantage with the strongest pooled indicators being ethnicity, life stage (children under 5 years in the household) and household tenure. Furthermore, the corresponding chi-square values are all relatively high. This grouping of attributes is not especially characteristic of rural populations and is therefore likely to reflect the 'urban' periphery components of host communities.

Table 3: Pooled results for comparing WWTP host communities with source communities (N=31)

	Education	Ethnicity	Occupation	Employment	Children	Tenure
Pooled Ratio values	1.05	1.15	1.07	0.98	1.15	1.13
Host-source relativity	disadv.	disadv.	disadv.		disadv.	disadv.
Chi-square	153.78	215.38	315.00	0.63	47.58	187.86

The average host/source ratio of median household income is 1.01, ranging from 0.69 to 1.65. Sixteen cases have a ratio <1.00 (i.e. the median household income for the host community is less than that for the source community) while 14 cases have a ratio >1.00. Thus, host and source communities are not clearly distinguishable on the grounds of household income distribution.

As regards a comparison between selected host communities and alternative host communities, a pooled analysis for eight cases was carried out, revealing mixed results. Three demographic variables (education, ethnicity and household tenure) indicated a bias towards relatively disadvantaged candidate host communities in the short-list situation, while one variable (life stage, children under 5 years old in the household) indicated the reverse. As shown in Table 4, the strongest indications of social disadvantage (ratios >1.00) in the site selection process relate to ethnicity and household tenure. However, the variable which indicates a bias against relative disadvantage - life stage - also shows a strong indication (ratio <1.00) although the strength of statistical inference (Chi-square) is relatively weak compared with the other variables.

Table 4: Pooled results for comparing selected host communities with alternative host communities (N=8)

	Education	Ethnicity	Occupation	Employment	Children	Tenure
Pooled R	1.05	1.29	1.01	1.05	0.81	1.31
Host-alternative host relativity	disadv.	disadv.			adv.	disadv.
Chi-square	17.94	34.13	1.02	0.23	6.40	25.89

Mixed results are also evident in the comparison of median household incomes between selected and alternative host communities. In five out of eight cases, the median household income level for the selected host community was lower than the alternative candidate host communities. The average ratio across all seven is 0.98 (ranging from 0.76 to 1.14), indicating that selected host communities have not been characteristically lower income communities than those which were not selected from the short lists.

6 Discussion

The results presented above are summarised very briefly in Table 5 for their indications of systematic bias.

Table 5: Inferences drawn from comparisons

Type of comparison		Landfills (solid waste)	WWTPs (waste water)
Host vs source	- demographic	No systematic bias	Systematic bias evident
	- median income	No disadvantage	No disadvantage
Host vs alternative host	- demographic	Strong systematic bias evident	Mixed results
	- median income	Systematic disadvantage evident	No disadvantage

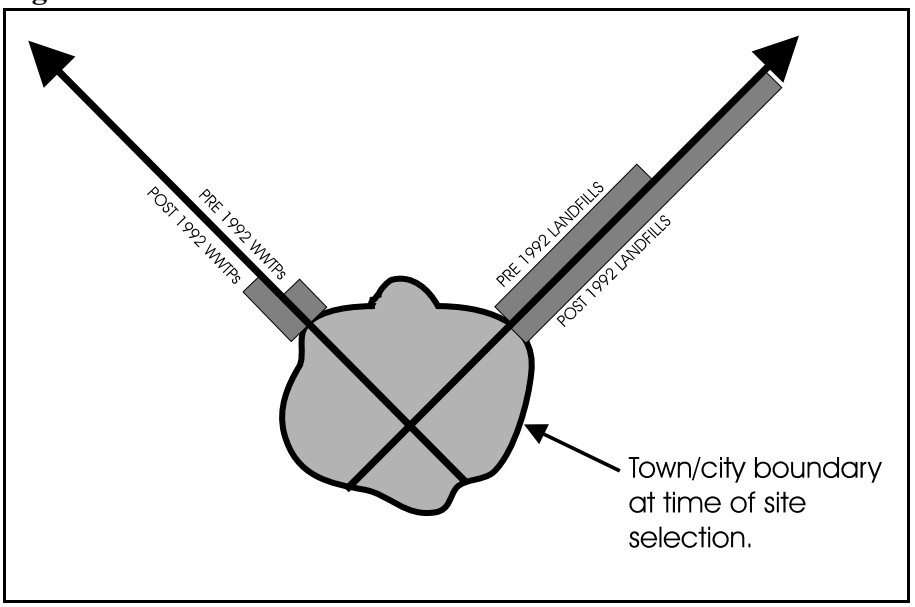
This research appears to have identified some evidence of systematic bias in the selection of waste facilities, when viewed from the perspective of host communities. It raises questions about whether or not these indications are the direct result of the planning process or more a matter of coincidence.

There are differences (in the nature of the activities as well as in the research results) between solid waste and waste water facilities, and these may be instructive in drawing conclusions.

In contemplating a proposed waste facility each potential host community must confront a variety of considerations. If it is a waste water facility there is the prospect that it may operate on that site indefinitely, whereas a landfill will have a fixed lifetime before it is full. Both types of facility bring the prospect of a range of negative off-site effects such as unpleasant odours, noise, even litter. However, waste water facilities often become the location for wildlife assembly, if large expanses of water are involved such as with oxidation ponds, or if a grove of trees develops as the result of irrigating effluent onto land. This has the potential to be viewed more favourably by neighbours.

A particularly important difference arises from the mode of transport of the waste material - solid waste is generally moved by truck, and there may be many trips each day, while waste water is pumped through underground pipes to the site. The heavy vehicle traffic associated with solid waste can be a major cause of annoyance to nearby residents. There are thus greater incentives to locate landfills further away from residential concentrations - out of sight if possible - than is the case for waste water treatment plants. Furthermore, economies of large scale are more favourable for solid waste operations than waste water treatment, leading to a trend for more remote regional landfills. Figure 3 summarises the comparison of distances from town boundaries for the two types of facility, and also compares the trend over time.

Figure 3: Distance From Town Boundaries



There is no doubt that landfills are more likely than waste water treatment plants to be in totally rural settings, and this is reflected in the host community vs source community comparisons. The comparison in Table 1 for landfills reflects the demographic characteristics of more rural populations.

Another major difference between the two types of facility is that there is generally less flexibility in the siting of WWTPs, bearing in mind the need to use the gravity effect to assist water movement, as well as the matter of proximity to receiving environment, if that be a river or estuary. Thus, WWTPs more often than not will be located in relatively low-lying areas which may correlate with less desirable residential locations. Hence, the comparison in Table 3 for waste water treatment plants reflects the more likely 'urban' periphery status of host community.

The comparison of host communities with alternative host communities is particularly revealing. For landfills, there is a complete reversal. The absence of systematic bias is not repeated when host communities are compared with 'alternative host communities'. Rather it reveals consistent bias towards relatively disadvantaged candidate host communities in the short-list situation. In other words, where there is greater choice of potential site on technical and logistical grounds, there is consistent evidence that more 'powerful' communities are able to influence the outcomes in their favour. The same freedom of choice on technical and logistical grounds is probably not available for siting waste water treatment plants, and the demographic comparisons do not show such a marked contrast.

Thus this research leads to the following conclusions. Firstly, even though there may be no deliberate bias in the planning process, the process is open to local political influence in more subtle ways. The research has produced findings that indicate a systematic bias in the outcomes of landfill siting decisions in New Zealand over the past 25 years. For the siting of waste water treatment plants, the results are less conclusive as to cause and effect. While there is some evidence of systematic bias, it is not clear whether this is a matter of deficiency in the planning process, or a matter of coincidence, determined by technical considerations. Several comments were offered during the

fieldwork to the effect that decisions on the layout of municipal infrastructure taken decades ago, can continue to influence site selection preferences even now. This legacy can become very constraining due to the scale of the costs involved in replacing existing infrastructure with new.

Two other findings are worthy of comment.

For both types of facilities, analyses on sub-samples which distinguish between pre-1992 decisions (Town & Country Planning Act) and post-1992 decisions indicate that any indications of systematic bias have become less under the RMA since 1991, although they have not necessarily disappeared altogether.

In all these demographic comparisons, where systematic bias is evident or suggested, ethnicity is the most consistent strong indicator of relative disadvantage. There would therefore appear to be similarities between the findings of this New Zealand research on the siting of solid waste and waste water facilities and Bullard's 1994 research on hazardous waste facilities in the US.

These social research programmes, which are on going, will now focus on the systematic assessment of actual effects from waste facilities. Fourteen case studies employing social research methods will be carried out, seven each of landfills and WWTPs. In due course - after June 2000 - the results of these case studies can be accessed via the Taylor Baines website.

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