Siting waste disposal facilities in New Zealand - how fair have we been?

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1 INTRODUCTION

1.1 Theme

The principal theme of the research reported in this paper is social and environmental equity in facility siting decisions.

A consideration of environmental justice issues in the siting of new waste management facilities requires impact assessment practitioners to understand relative equity between communities. Of particular interest is the relationship between source communities and host communities. Does the siting of these facilities reflect relative social, economic or political disadvantage between communities? For example, referring specifically to hazardous waste sites in the US, Bullard (1994) reported 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."

In New Zealand, there are no separate hazardous waste facilities. Many materials that would be classified as hazardous (e.g. asbestos, bio-medical wastes) are managed by the practice of 'co-disposal' in general dumps or landfills. Moreover, there is presently no analysis in New Zealand to indicate whether any particular social or demographic factors are evident in the siting of waste management facilities in this country.

Past practices such as the location of dump sites in river margins or in open shingle pits began to raise concerns about threats to freshwater resources in communities around the country. The traditional urban response of turning to the rural margins for a disposal site - out of sight, out of mind - also caused friction amongst different groups within the wider community. It is apparent that many of the concerns focus around a core issue of social equity - why should one section of the community accept the risks associated with disposal of the whole community's refuse? This concern is often also related to the NIMBY response (Not In My Back Yard). It raises questions about what constitutes socially unacceptable impacts in practice, and whether initial community concerns are borne out in actual experience.

1.2 Context and objectives

The research reported in this paper forms the first part of a three-year research programme that aims to assist the process of urban and rural planning in New Zealand. When completed, it will have assembled a body of knowledge on key social factors that are relevant to decisions on the siting and operation of solid waste facilities in this country. The research has been funded by the Government, out of its Public Good Science Fund.

The first part of the research programme is intended to answer two central questions:

1. Is there a systematic pattern of landfill siting in New Zealand?

2. If so, how would this historical pattern be characterised from the social perspective of the host communities involved?

The second part of the research (being carried out at present) is intended to ask two further questions:

3. What have been the day-to-day effects and the longer-term effects on host communities of landfill and transfer station operations?

4. How do actual effects compare with effects that were projected at the time of siting?

Thus the research programme begins by identifying historical patterns and trends in landfill siting and then leads on to document actual host community experience of the effects of landfill siting decisions and operations.

1.3 Institutional setting

The passing of the Resource Management Act (1991) put the focus of land-use planning in New Zealand onto an effects-oriented basis. In other words, instead of using a land zoning approach, activities such as solid waste dumping can in future be located anywhere so long as their off-site effects can be kept within acceptable limits. The implications of this for refuse disposal practices have become increasingly apparent in recent years. The need to obtain specific resource consents for the on-going use of existing refuse disposal facilities (in the past most aptly referred to as "tips" or "dumps") has highlighted the unsustainable outcomes of past practices and past trends.

2 RESEARCH METHODS

2.1 Sample selection

The sample of facilities (Appendix I) includes both landfills (27 in total, with demographic data for 22) and transfer stations (8, with demographic data for all of them) were drawn from a national data base of waste management facilities. 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). Communities with usually-resident populations of fewer than 4000 were excluded from the sample.

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

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

(v) cases where the choice included continued use of an existing facility/site and those where only new sites were considered. In fact, preference was given to new sites.

(vi) practical considerations such as regional clusters of sites, to minimise field travel time.

The most important constraint was the availability of demographic statistics which were obtained for 1981 onwards, from the 5-yearly censuses. Another constraint, was the loss of institutional memory in the Territorial Local Authorities (TLA) where several cycles of re-organisation and loss of personnel meant 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.

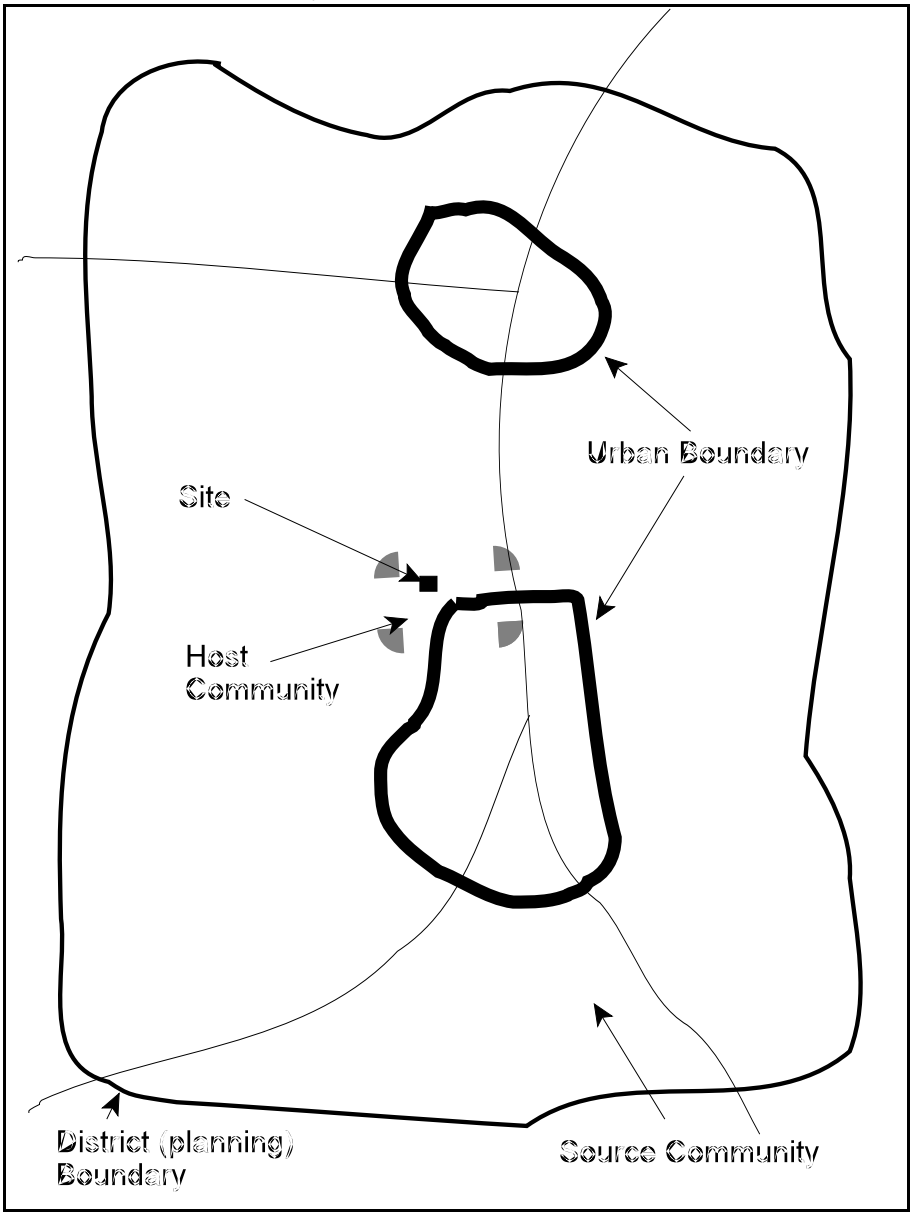
2.2 Site visits and interviews

Information was gathered from a range of sources. Some background information was sourced from the 1995 Landfill Census database, commissioned by the Ministry for the Environment, prior to visiting the facility operators. These site 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 database for systematic analysis.

2.3 Specifying 'host communities' and 'source communities'

The research employs the concepts of *'source community'* and *'host community'*. The term *'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. The 'source community' incorporates all those who generate solid waste which requires either handling in a transfer station and/or disposal at a landfill (see Figure 1 below). The term *'host community'* is used to refer to the community resident in the geographic area most clearly associated with a particular solid waste facility. It is not limited 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. In a sense, all distinct local communities within a 'source community' are potential 'host communities' at the time a site selection process is initiated.

Figure 1: Relating the concepts of 'host community' and 'source community'



2.4 Demographic analysis

Based on the fieldwork, the research team met to finalise the host community specifications so that the corresponding statistical areas could be mapped in relation to census boundaries.

In looking for appropriate social indicators, 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 solid waste facilities, which are usually subject to adverse expectations.

The seven variables selected 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
Tenure	% of private dwellings that are NOT owned by the occupant
Income	median household income

3 MAIN FINDINGS

3.1 Overview

Volumes of solid waste generated in any community are proportional to the numbers of people in that community, and, within that community, proportional to the degree of consumerism engaged in, which often correlates with household income. It is therefore logical to conclude that larger communities generate most solid waste. Also that wealthier sections of the community tend to produce more solid waste than not so wealthy sections.

Considerations of social equity revolve around the question of the extent to which those who generate the waste also take responsibility for living with the effects of the waste generation - the negative impacts of transporting and disposing of the waste. Thus indications of social equity or inequity are likely to be found within communities in terms of demographic differences, and between urban and rural communities in terms of siting distances.

Findings on each of these aspects are summarised below.

3.2 Demographics

Host communities were compared with source communities by examining the ratio between 'observed' and 'expected' values 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 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.

The results discussed in this paper are only for landfills. The total number of landfill sites involved in the statistical analysis is 22, with 12 being subject to the 'host' vs 'alternative host' comparison.

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".

Comparing selected 'host communities' with source communities (N=22):

The pooled results over all 22 landfill sites reveal that host communities are typically different from source communities when analysed for indicators of 'power to influence decisions'. However, there is no consistent bias towards relative disadvantage in host communities, as shown in Table 1 and Figure 2. 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 landfill sites (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).

Analysis of comparisons for each individual site leads to two further observations:

(a) even where the pooled results for one indicator (e.g. educational status) point to a statistically significant difference for the whole sample, there is still considerable variation within the sample of sites,

(b) there appears to be a trend over time - a greater incidence of significant disadvantage in earlier siting decisions and a lower incidence in more recent decisions.

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.

Comparing selected host communities with short-listed alternative host communities (N=12):

Systematic bias towards relatively disadvantaged host communities in site selection is, however, evident 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 and Figure 3. The twelve cases include eight where decisions were made under the new Resource Management Act (1991).

Figure 2: Pooled Ratios (R-Values) - Host Communities vs Source Communities (N=22)

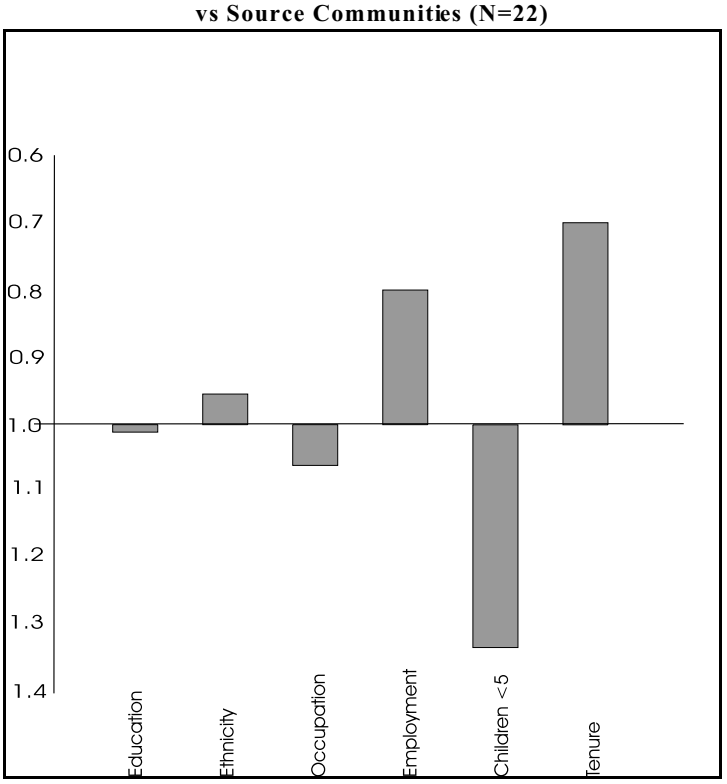


Figure 3: Pooled Ratios (R-Values) - Host Communities vs Alternative Hosts (N=12)

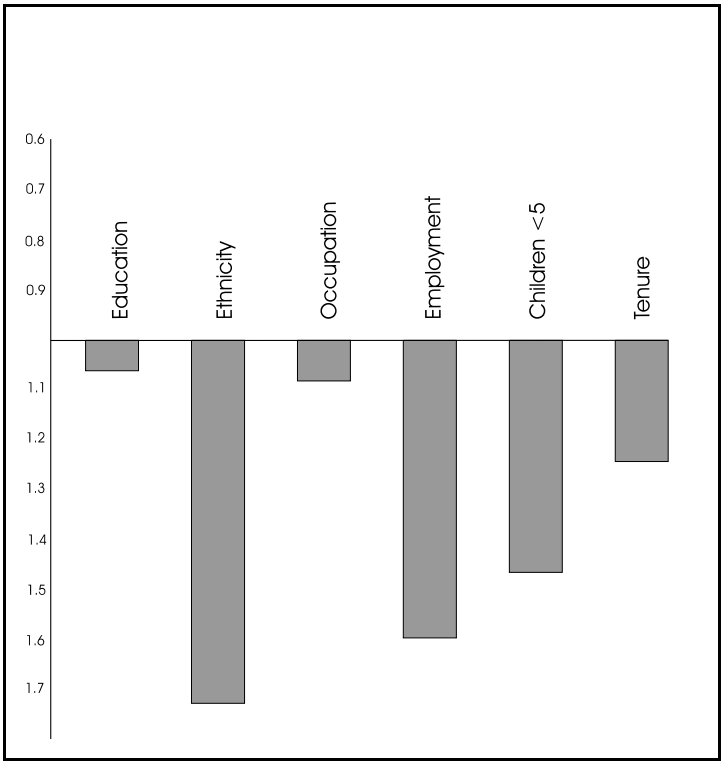


Table 2: Pooled results for comparing selected host communities with alternative host communities (N=12)

	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.

Analysis of individual sites shows much less variation than was the case for the host-source community comparisons, although there is the suggestion of a similar trend over time.

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.

3.3 Distance from town boundaries

There has been much debate in recent site selection exercises on the question of 'how far out of town a landfill should be put, in order to protect (urban) residents from the negative impacts of landfill operations?' This is clearly an urban perspective, given that urban consumers generate by far the largest proportion of the solid waste disposed of in any landfill. It is not a view that attaches much importance to the rights of (relatively small numbers of) rural dwellers to maintain their existing rural amenity values in the face of a landfill proposal.

The research explored this question by estimating the distance to the nearest town or city boundary. In some cases, landfills have been developed inside urban boundaries, or immediately adjacent to the boundary. In addition to these cases, the sample of landfill sites has been analysed using three bands of distance, as shown in Table 3.

Table 3: Relationship of landfill site to town or city boundary - time series

Era of opening	Inside	Adjacent	0-1km	1-5km	>5km
1972-76			3	2	
1977-81	1*		1	1*	
1982-86	1			1	
1987-91		1			1
1992-97	4**		1	1*	2
Yet To Be Opened			1	2*	4
Totals	6***	1	6	7***	7

(*) denotes cases where use of an existing site has been extended. The number of asterisks indicates the number of cases.

There is a trend evident in recent years towards locating landfills at greater distances from urban boundaries. Prior to 1992, only one-in-ten sites was located more than 5km outside the urban nearest boundary, whereas since 1992, over half the sites chosen have been more than 5km away. This trend also appears to correlate with the shift to landfills

that prohibit public access in favour of restricted access to dedicated waste transfer vehicles and a relatively small number of commercial vehicles licensed to take waste directly to a landfill rather than to a transfer station.

3.4 Separation from existing dwellings

Much effort is often expended in trying to find 'isolated' sites - isolated in the sense that they provide for adequate physical separation between proposed landfill and existing dwellings, whether they be isolated rural dwellings or more consolidated urban settlement. Separation distances were estimated as direct, straight-line distances, even though in some cases there was no direct line of sight from dwelling to facility site for reasons of local topography. Results from this analysis are given in Table 4.

Table 4: Separation distances for landfills at time of site selection

Era of opening	0-500m	500-1000m	1-2km	2-3km	3-4km
1972-76	2	1	2		
1977-81	1*	1		1*	
1982-86			2		
1987-91		1	1		
1992-97	3**	2	1	2*	
Yet To Be Opened	2*		3	1	1

(*) denotes cases where use of an existing site has been extended. The number of asterisks indicates the number of cases.
Sources: site observations, aerial photographs, maps

The results indicate an increasing separation distance for more recent site selection decisions. Prior to 1992, separation distances in the sample exceeded 2km to the nearest dwelling in one case out of twelve. Since 1992, just over one quarter of the new sites have had separation distances in excess of 2km.

4 DISCUSSION

4.1 Overview of the research findings

Planning and site selection for solid waste facilities are activities which can engender considerable public debate. Frequently, residents of potential host communities express concerns about the fairness of the site selection process - "why should we have to accept everyone else's waste?" Such concerns are triggered both by perceptions of the planning process as well as by perceptions of the effects the facility can be expected to have on the host community.

The patterns and trends observed in this research are summarised as follows:-

the trend has been away from pre-determining the locations of landfills and transfer stations through long-term planning provisions to an emphasis on effects;
criteria for landfill siting are focussed around the desire to balance 'distance from residential areas' (reflecting costs to host communities) against 'proximity to waste sources' (reflecting costs to source communities). Protection of high standards of water quality is a universal priority in all host communities;
there are now fewer, larger landfill facilities.
in landfill siting there is a clear trend towards greater separation distances from residential areas with the emphasis on more rural locations where farming is the predominant land use on or around the site. Although the number of sites where the working face of the landfill is visible to neighbours is proportionately higher in recent cases, there are typically fewer dwellings involved;

a simple comparison of host communities with source communities suggests that there is no systematic bias towards relatively disadvantaged host communities in the site selection process for landfills.
But comparison of selected host communities with alternative candidate host communities suggests that during the process of site selection, more powerful candidate communities are consistently more effective in avoiding final selection.

Overall, these trends reflect deliberate attempts to try to minimise the impacts of solid waste facilities on their host communities - seeking more remote sites, or sites with a degree of screening provided by topography or tree planting. While the planning process therefore appears to be sensitive to issues of physical effects, the social-demographic analysis suggests there is an additional feature of the planning process to consider. There appear to be political influences in decision making, a conclusion that supports host community concerns expressed about the fairness of the siting decisions taken.

The findings suggest a systematic bias in the outcomes of site selection decisions, but not necessarily a deliberate attempt to use the planning process to inflict social injustice on disadvantaged communities. However, the findings suggest that it would be prudent to examine the planning and site selection procedures to ensure that decision-making criteria are more transparent. This will be particularly important in situations where profiling of candidate host communities reveals systematic differences in the socio-economic status of the various candidate host communities. Transparency in decision making requires that the criteria and analytical logic used in site selection decisions are made explicit. There is also a clear case for including social assessment throughout the site selection process (Taylor, et al., 1996).

4.2 An obligation to examine alternatives

Section 32 of New Zealand's Resource Management Act places on local government certain "duties to consider alternatives". This principle applies to the establishment of public policies and institutions as well as to the development of new infrastructure.

Presently, the screening procedure usually involved in site selection means that often only one site is subject to detailed planning investigations. Perhaps several of the alternative candidate sites need to be subject to more rigorous investigation so that a genuine comparison can be made prior to final site selection. This would make the critical discriminating criteria clearer, and avoid the suspicion that other considerations such as socio-economic status and political influence were decisive, but hidden, factors.

There exists a challenge for impact assessment professionals - to carry out a more thorough, integrated, assessment on alternative sites, and to use more rigorous analytical methods and approaches. For this to happen, the impact assessment professionals will need the mandate from the client (either local government or private facility developer) and the resources to make more rigorous assessment happen.

Aspects of public consultation are worth considering as well. Firstly, ensuring adequate representation of alternative host communities in the public consultation process, so that the communities are involved in the short-listing and comparative assessments. This means that communities must have input to the choice of site selection criteria, and decision making logic in order to give credibility and transparency to the site selection process.

4.3 The siting dilemma

It is no longer an easy task to find 'un-inhabited' spaces in the countryside. Since the Resource Management Act was passed, rural land in many parts of the country has been opened up for a variety of non-traditional activities, particularly land that is within the desired commuting radius from urban centres.

Given the virtual impossibility of avoiding completely all the negative impacts on any 'residents', the question for impact assessment professionals thus becomes one of whether we can usefully discriminate between one locality and another. The challenge certainly exists to ensure that facilities such as landfills are sited, designed and operated in such a way that they would not cause unacceptable effects on the host community, regardless of the socio-economic status

of the community concerned. This assumption is implicit in the fact that site selection criteria often do not mention socio-economic status as a discriminating criterion.

It is reasonable to assume that the concerns expressed by potential host communities about social justice in site selection are motivated by a desire to see that socio-economic status is not being used implicitly as a selection criterion. Similarly, this issue reflects concerns that disadvantaged communities are less well positioned to exert what they might see as inappropriate political influence in the site selection process.

4.4 Ongoing research - actual effects of landfills on their host communities?

Community concerns about fairness are triggered both by perceptions of the planning process and by perceptions of the effects the facility can be expected to have on the host community. The latter aspect provides the focus for the next stage of this research programme. From the sample of facilities analysed and reported here, seven have been selected for case study investigation. The case studies will assess the short-term operational effects and long-term developmental effects of these facilities as experienced by the host communities. The results of the case studies will be documented for widespread dissemination and reference in New Zealand. Thus the results will provide an information resource for all parties in future site selection exercises, as well as to people in other professions such as real estate and land valuation. We hope to be able to report the results of the case study research to a future IAIA Annual Meeting.

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APPENDIX I: Characteristics of the sample of solid waste facilities

Descriptor		Full sample[a] of Landfills	Restricted sample[b] of Landfills	Sample of Transfer Stations
Total sample size		27	22	8
Size of 'source community'/facility:				
Large = source communities >100,000		8	7	4
Medium = source communities 20,000-100,000		11	8	1
Small = source communities <20,000		8	7	3
Era of opening:	1972-76	5	-	-
	1977-81	3	3	1
	1982-86	2	2	2
	1987-91	2	2	-
	1992-97	8	8	4
	Yet To Be Opened (YTBO)	7	7	1
Planning legislation operative:				
Town & Country Planning Act		16	11	3
Resource Management Act (1991)		11	11	5
Existing use/new use:				
Site already in use for solid waste purposes		7	7	3
New site - no previous solid waste use		20	15	5
Public access to the facility:	Public access	12	7	8
	No public access	15	15	-
Type of landfill liner:	No liner at all	7	5	Not applicable
	'Natural' liner[c]	15	12	
	'Engineered' liner[d]	5	5	

a 'Full sample' refers to the sample of 27 landfill facilities/sites, for which demographic statistics were available.

b 'Restricted sample' refers to the sample of 22 landfill facilities/sites, for which demographic statistics were available to the researchers.

c As described in the Ministry for the Environment's 1995 Landfill Census questionnaire, a 'natural' liner refers to the use of *in situ* material of low permeability.

d As described in the Ministry for the Environment's 1995 Landfill Census questionnaire, an 'engineered' liner refers to one that is constructed of natural and/or synthetic materials which have been brought to the site for this specific purpose.4