

AN EVALUATION OF THE HORNBY ISLAND RECYCLING PROGRAM
AND ITS IMPLICATIONS FOR MUNICIPAL SOLID WASTE MANAGEMENT

by

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ABSTRACT

Municipal solid waste recycling not only has an immediate impact on the landfill crisis through reducing the waste stream flowing into landfills, but also helps to conserve valuable resources and protect the environment. Although recycling is taking place in many cities all over the world, very little attention has so far been paid to the problems associated with it in small communities. This study examines the effectiveness of a recycling program, in dealing with municipal solid waste in small communities, through a case study of the Hornby Island recycling program.

The research focused on the evaluation of the program and investigated its development. The main research tools utilized were personal interviews and a mail questionnaire survey, which was sent to all the permanent households on the island. A response rate of 37 per cent was achieved.

The study develops a methodological framework for evaluating small community recycling. The criteria established to evaluate a recycling program are the materials recycled, recycling quantity and rate, financial feasibility, and public awareness, participation and acceptance. Based on these criteria, the Hornby Island recycling program was assessed as very successful. The development of the program was investigated in the light of the conceptual framework adapted from innovation research, these concepts were discussed in terms of the developmental process and the key factors which have contributed to the diffusion of recycling on the island. Two conclusions were derived from the survey and the theoretical discussions. Firstly, the program has passed the final stage of hindsight evaluation and

modification, and has entered a new stage of exporting recycling to other communities. Secondly, a need for recycling, the establishment of a recycling committee, the roles of key individuals, the cultural history and local decision-making in favour of recycling, the homogeneity of the population and their positive attitudes towards recycling, and effective education and regulations were considered to be some important factors in the diffusion process. However, further research is required to validate the findings.

The implications of this study and some recommendations derived from the survey and theoretical discussions that have a bearing on small community recycling are also presented.

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Chapter 1

INTRODUCTION

The disposal of municipal solid waste has, in the past two decades, become an urgent global problem. The United States, for example, generates an average of more than 362,800 tonnes of municipal solid waste a day, a national total of roughly 140 million tonnes a year (O'Leary, Walsh and Ham, 1988; Neal and Schubel, 1987)¹. In British Columbia, each person on average produces 2.2 kilograms of municipal solid waste a day. As a consequence, the province generates some 2,400,000 tonnes of municipal solid waste a year (Municipal Solid And Biomedical Waste Branch, 1990). The question of how society should dispose of this huge amount of solid waste encompasses some of the most complex and urgent environmental issues of our time. The situation is worsened by the fact that, at the same time as the volume of municipal solid waste generated has increased, its composition is adversely altering. This is because the proportion composed of complex synthetic and non-biodegradable compounds is growing, creating extraordinary technical, health, environmental and political problems.

Current disposal options are generally regarded as

¹A recent survey of 50 states of the United States undertaken by BioCycle Journal shows that approximately 226.75 million tonnes of municipal solid waste were collected in 1988.

limited in variety and inefficient in nature. The primary method is landfilling, which is used to dispose of over 80 percent of the world's municipal solid waste. However, existing landfills in many urban areas are being filled at an ever-increasing rate, creating serious problems for many communities. Similarly, because of poor management and the deleterious effects of these sites, most landfills have been causing serious environmental deterioration. Many problems associated with landfills such as groundwater contamination, odour, dust, litter and vermin make acceptable new sites difficult to identify, and often nearly impossible to acquire because of the NIMBY (not in my back yard) opposition.

Increased municipal solid waste generation, greater persistence of chemicals and decreasing space for landfilling combine to set the stage for major changes in the way society deals with solid waste disposal. Many people have suggested a need to have a more creative and long-term view in our search for solutions. In recognition of this, innovations, such as recycling, designed to tackle this dual threat, are being seriously tested on small scales. Communities in Canada, the United States, France, Greece, and Japan have developed a variety of recycling programs in an attempt to deal with their municipal solid waste (Peters and Grogan, 1988; Frantzis, 1988; Arlosoroff, 1988; and Logsdon, 1988).

Yet, despite the growing interest in, and obvious benefits of, recycling, its introduction has been controversial. Whereas some communities have enjoyed success in recycling, others have run into some serious problems. For example, Wilton, New Hampshire has achieved a 65 percent participation rate, producing an estimated about 100 kilograms of recyclable waste material per person per year in its recycling program which serves 8,500 people. This enables Wilton to divert 44 percent of its waste stream, generate an annual revenue of \$26,700 and save \$50,000 to \$100,000 in disposal costs per year (Peters and Grogan, 1988). With a participation rate of 98 percent, Woodbury, New Jersey is diverting 50 percent of its waste stream through recycling (Grogan and Bell, 1989). However, some communities in Ontario and the Atlantic Canada have found themselves with huge piles of recycled newspaper for which there are no available markets. Markets there collapsed when a high stream of recyclable materials became available in 1989 after state laws in New Jersey and New York required cities to start recycling programs. Some municipal officials there reported that they were able to sell used newsprint for \$45 a tonne in 1988, but in 1989 must pay \$18 a tonne just to have it hauled away. The recycling centre in Victoria, British Columbia, was burnt down in 1989 by a fire because of poor supervision. For this reason, it is very important to establish how effective recycling is in relation to other alternative methods of

municipal solid waste management. This thesis helps to throw light on this question, by studying in detail the responses of one small, isolated community (Hornby Island) to its municipal solid waste recycling program. The municipal solid waste problems in small communities are significantly different from those experienced by large cities, and therefore require distinct management strategy. The evaluation of the Hornby Island recycling program will have some implications for small community municipal solid waste management.

A number of important, yet complex and difficult questions arise when examining the effectiveness of recycling in municipal solid waste management. Glysson et al (1972:1), have pointed out the sheer diversity of the problems of solid waste disposal:

"Just as the overall problem is concerned with thousands of heterogeneous material substances, so it comprises immaterial sub-problems that must be also numbered in thousands. Some of these sub-problems are political, and raise questions of proper action at all levels--municipal, provincial and federal. Some are economic, and raise questions of manufacturing efficiencies, sale strategies, short-range profits as against long-range resource allocation. Some are ecological, and raise questions of growing mismatch between 'natural' absorptive capacities of the environment and the 'unnatural' demands being made upon them. Some are sociological, some are aesthetic, and some inescapably private, having to do with individual aspirations toward the good life and individual decisions about what in fact the good life is."

Because of this complexity, this thesis does not attempt to

provide a comprehensive discussion of recycling. Rather it seeks to evaluate the Hornby Island recycling program, in an effort to shed some light on the potential effectiveness of recycling as a component of municipal solid waste management. As such it is essentially a case study of innovation diffusion. However, it focuses primarily on how the program was developed, using the theory of innovation diffusion as a framework for interpretation.

This research project has three specific objectives. Firstly, it attempts to evaluate the Hornby Island recycling program. The overall evaluation consists of two components: a technical analysis conducted to estimate the type and quantity of the materials being recycled, and the revenues and costs of the program. A public opinion survey was also undertaken to assess participation rate in the program, and attitudes towards recycling.

A second major objective is to trace the development of the recycling program. Diffusion theory will be used as a framework to better understanding why this innovation was adopted. Discussion is based on data collected, both during interviews, and from a questionnaire survey. The information is used to review the program's initiation and implementation, and to conduct a hindsight evaluation. Emphasis is placed on leadership, structure and the mechanics of the program.

The third major objective is to assess the applicability of the Hornby Island recycling program to other island communities in The Capital Regional District. A brief comparative assessment of current waste management practice is provided to see whether suggestions can be made on ways of potentially improving waste management in the Capital Regional District.

Six chapters follows this brief introduction. In the second chapter, the literature on municipal solid waste and its disposal is reviewed, in order to provide a framework for the study. Definitions of municipal solid waste, problems in its disposal, and different disposal methods are examined. Primary attention is paid to the benefits and costs associated with landfill, incineration, composting and recycling. The conclusion is reached that perhaps recycling provides the best hope of eliminating, or better allocating, the problems facing municipal solid waste management today.

Chapter 3 provides an overview of the Hornby Island recycling program, and explains why it was chosen as a case study. This examination of the Hornby Island recycling program supports the speculation that the wider application of some of its approaches may offer a useful solution to certain municipal solid waste problems. Evaluation of the program may provide a baseline from which to assess other community

programs. In addition, it may contribute to a better understanding of public attitudes and behaviour towards recycling and innovation theory.

Study design is discussed in Chapter Four. Theories developed elsewhere in order to better understand the diffusion of innovation provides its conceptual structure. Following the presentation of this theoretical framework, the central concern of the chapter is relevant data collection. The technique employed was a mail questionnaire, supplemented by personal interviews. The discussion concludes with a review of data analysis.

The chapter that follows examines the structure of the Hornby Island recycling program, and provides a data-based evaluation using information derived from questionnaires and interviews. This allows an assessment of the extent to which the program has been successful in dealing with the community's solid waste problem.

The final two chapters employ the theoretical framework of innovation diffusion, introduced earlier, to interpret the development of the program. They also assess implication of Hornby Island's approach to waste management for The Capital Regional District.

Chapter 2

RECYCLING OF MUNICIPAL SOLID WASTE

As a result of growing social awareness of the problems posed by municipal solid waste disposal, and increasing interest in recycling, a good deal of research has been undertaken, and the literature on recycling is now extensive. As a first step in research on the Hornby Island recycling program, a literature review was undertaken. This is subdivided here into two sections: (1) municipal solid waste, and (2) recycling of municipal solid waste.

2.1. Municipal Solid Waste

2.1.1. Definition

A review of the literature on this topic illustrates the confusion over exactly what constitutes municipal solid waste. Terms such as garbage, refuse, trash, domestic waste, household waste, and residential waste are often used interchangeably. This is largely because the specific meaning of each term has not been strictly defined. For example, the public often refers to municipal solid waste as garbage, refuse or trash, terms which, according to the Merriam-Webster Dictionary (1984), simply mean unwanted or useless (worthless) materials, or something of little worth. Stone (1988:22) defines municipal solid waste as solid waste from any source, which enters either the collection, or disposal, systems

operated by municipalities, or regional districts. Stone excludes the portion which is recycled at source prior to collection, and the industrial, or commercial, waste disposed of on site, or at private disposal facilities. A more thorough, but similar definition was also given by The U.S. National Centre for Resource Recovery (1974:1) which defines municipal solid waste as "those obsolete products discarded by domestic, commercial and municipal consumers which would normally be deposited at municipal refuse disposal areas". Since an extensive study of the Hornby Island recycling program requires the establishment of concrete working parameters, the definition by the Centre for Resource Recovery has been adopted for this study.

2.2.2. The Composition of Municipal Solid Waste

A number of authors have attempted to quantify the composition of municipal solid waste. As shown in Table 2.1, considerable differences exist in the data presented, particularly for the paper fraction, which varies from 20 to 50 per cent.

Although municipal solid waste is only a small portion of the overall solid waste stream², it is the most concentrated

² "From both industrial and municipal sources, the U.S. generates about 10 billion tonnes of solid waste per year. Municipal solid waste only accounts for 140 million tonnes", which accounts for 14 percent of the solid waste. From O'Leary, P.R. and P.W. Walsh in Scientific American Vol.259, No.6. December 1988.

Table 2.1: Composition of Municipal Solid Waste (by weight %)

Source Composition	B. C. (1)	(2)	Alberta (3)	Ontario (4)	Canada (5)	U.S.A (6)	U.K. (7)	OECD (8)
Paper & Board	41.5	45	30-50	35	36.4	34.95	32.5	20-45
Glass	8.2	8.2	5	8	6.6	8.95	7.9	6-13
Metal	9	9.6	5	8	6.6	8.08	7.1	4-11
Plastics, Rubber & leather	8	5.7	5	5	4.6	2.55	1.0	3-8
Organic Materials	23	20	33	37	35.7	43.2		
Wood & textile		8.1		5	8.5	2.2	2.2	3-5
Rock & Dirt Cinder	5.9	2.5					37.4	17-36
Other	4.3			2	3.5			

Sources: (1) Stone, M. (1988).
(2) Stanley Associates Engineering Ltd. (1981).
(3) Free, B. (1985).
(4) Ontario Waste Management Advisory Board. (1980).
(5) Environmental Council of Alberta. (1987).
(6) National Centre for Resource Recovery, Inc. U.S.A. (1974).
(7) Holmes, J. R. (1981).
(8) OECD. (1983).

and constitutes the most immediate and obvious problem area. This form of waste is causing serious environmental deterioration and economic losses in our urban society (OECD, 1983; U.S. National Centre for Resource Recovery, 1974).

2.2.3. Municipal Solid Waste Disposal

The primary municipal solid waste disposal options are landfill, incineration, composting and recycling. A survey by the Journal of BioCycle suggests that about 243,000,000 tonnes of municipal solid waste are generated in the United States annually, between 83.5 and 83.9 per cent is landfilled, with 7.8 to 7.9 per cent processed through incinerators and 8.3 to 8.6 per cent being recycled (Glenn, 1990). According to the information from Environment Canada, about 82 percent of the municipal solid waste generated in Canada was landfilled in 1989, with about 11 per cent recycled and 7 per cent incinerated. Municipal Solid and Biomedical Waste Branch of B. C. Ministry of Environment (1990) reports that only 7 per cent of the municipal solid waste generated in B. C. was recycled, about 10 per cent was incinerated, but over 80 per cent was landfilled in 1989.

Each of the above methods has come under increased scrutiny as a result of changing regulatory laws, new technical findings, and growing community concerns and needs, and the effectiveness of each may differ from one location to

the next. In this section, an attempt is made to compare and contrast the advantages and disadvantages of the each option.

Landfill

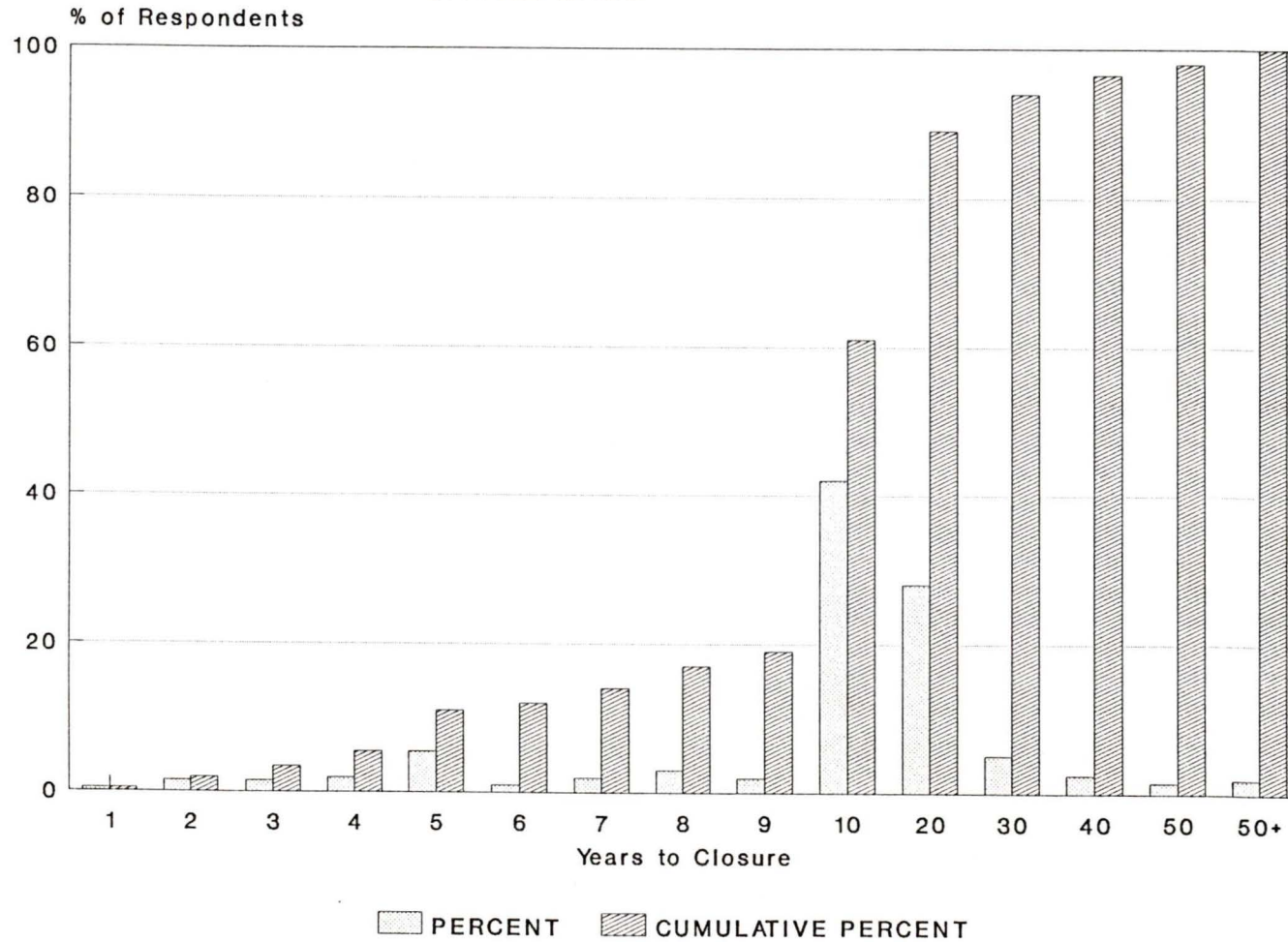
Landfill is an extension of the age-old open dumping which discards municipal solid waste at a designated location. In the past half-century, the combined environmental impacts of smoke pollution, odour generation, attraction of pests, water contamination and other disadvantages associated with open dumps have led to a considerably improved practice, sanitary landfill. In a sanitary landfill, each day's addition is, in theory, covered promptly with an odour-and-vermin-preventing layer of earth. Such landfills can accept a wide variety of materials, and if properly managed, can significantly reduce odour and access by vermin and enhance decomposition of degradable materials. Where land is available, it is the most economic method of waste disposal.

Sanitary landfill continues to be the most common disposal method, but time appears to be running out on burial as the main option, since many landfills have already reached their capacity. The 6,000-mile 71-day odyssey of a U.S. barge seeking in vain to dispose of its 2,800-tonne cargo of trash highlights the approaching crisis of municipal solid waste management in the country (Abelson, 1987). Many large cities

in the United States, such as New York and Seattle, are expected to run out of landfill sites within 3 to 5 years, and by 1990 half of the landfills in the U. S. are expected to be closed (Abelson, 1987; Neal and Schubel, 1987). Similarly, landfill facilities in Canada are also rapidly reaching their capacities. Across the country, cities are running out of places to dump this waste material. For instance, some 160 landfills in Ontario have less than two years of remaining capacities (Environment Ontario, 1990). In British Columbia, 60 per cent of the dumps will be overflowing within ten years (Figure 2.1). As existing space fills up, new landfills are becoming increasingly difficult to establish, as local pressure groups strongly object to locating landfills in their neighbourhoods. This has been clearly demonstrated by the Greater Vancouver Regional District's experiences with its plan to haul almost a third of Vancouver's garbage 350 kilometres up the Fraser Valley to Cache Creek (Munro, 1988).

In addition to the extreme social difficulties of locating new landfills, there is a growing recognition of environmental problems such as contamination of groundwater by leachate linked to such landfills (Abelson, 1987; White, 1983; Environment Council of Alberta, 1986; The City of Portland, Ontario Waste Management Advisory Board, 1980; and Fenge, 1976). By 1984, the United States Environmental Protection Agency had identified over 400 landfill sites, where

Figure 2.1: Remaining Service Life at B. C.'s Existing Landfill Sites



Source: B. C. Ministry of Environment (1988).

groundwater contamination had reached such levels of severity that specific remedial action had to be taken, to prevent a direct threat to drinking water (Neal and Schubel, 1987).

For instance, the contamination of groundwater is causing problems to the sole source of drinking water for the more than 3 million residents of Nassau and Suffolk counties on Long Island, New York (Neal and Schubel, 1987).

Improperly sited, designed and operated landfills can accumulate significant quantities of dangerous chemicals, which may leave the landfill area as runoff, or leachate, and enter streams that eventually empty into lakes, reservoirs or rivers which provide water for human use. Toxic leachate from the landfills is extremely harmful to human health and to wildlife. If a landfill's capacity to hold water is exceeded, leachate escapes into the environment in quantities, concentrations, and directions which are very difficult to predict. Surrounding surface waters, aquifers, and sometimes the entire ecosystem may be contaminated by such leachate. Landfill also produces methane, a colourless and explosive gas, which may also seep underground into nearby buildings causing explosions and fire (O'Leary, Walsh and Ham, 1988).

A study by the U.S. Environmental Protection Agency shows that a majority of landfills in that country are poorly sited and improperly managed and many are little better than open

dumps, lacking in adequate safeguards to minimize environmental damage (Neal and Schubel, 1987). Therefore odours, flying litter, vermin and other deleterious effects of open dumps are still associated with most sanitary landfills. For example, fewer than 20 percent of approximately 500 existing landfills in New York State have (or could qualify for) the proper environmental permit (Neal and Schubel, 1987).

The cost of landfilling is also rising rapidly. In California, the landfill rate will rise from \$16-\$22 a tonne to \$55 a tonne. On Long Island, New York, landfill costs already exceed \$110 a tonne. In B. C., the cost at Hartland landfill in Greater Victoria rose from \$22.58 a tonne to \$30 a tonne on June 30, 1990, and the fee jumped from \$22 to \$50 in Nanaimo (Paterson, 1990a). The Director of the Los Angeles Recycling Program, Joan Edwards, predicts that the future cost of landfilling will be astronomical (Paterson, 1990a).

Furthermore, as a result of the current style of management, potentially recyclable materials such as paper, glass, metal and plastic are being rendered inaccessible, and the land in which these valuable resources are buried is being diverted from other, and perhaps more beneficial, uses. The value of energy originally used to extract, refine and process these resources is also being lost (Ontario Waste Management Advisory Board, 1980).

Incineration

In light of problems associated with landfilling, it has become necessary to consider alternative disposal methods. In desperation, many cities are turning to incinerators, such as the new plant in Burnaby, B. C. The modern incineration process involves controlled burning, at very high-temperatures (more than 1000°C), in special facilities called resource recovery plants. These facilities can substantially reduce the amount of municipal solid waste and produce ash as the only solid residue requiring disposal. Some of the energy produced by burning the waste can be recovered and used to generate steam for heat or electricity. Despite the apparent attractiveness, this alternative is also not without its problems. Concerns about high-temperature incineration focus on the high expense, the emissions and their possible health hazards, and the residual ash disposal.

Incinerators require high initial capital investment, Kirkpatrick (1989) estimates that, in Florida, the cost of incineration is \$110 million per thousand tonnes a day design capacity. An incinerator also usually takes three to five years to construct. In addition to being expensive, air pollution is a major concern since emission contains particles, and unburned, volatile compounds such as hydrochloric acid, nitrous oxides, dioxins and furans. The ash left after burning is also toxic and difficult to dispose

of. The plight of the freighter, the Khian Sea, clearly demonstrated the difficulties involved in disposing of the incinerated ash. Carrying 11,800 tonnes (or 13,000 tons) of incinerator ash, the Khian Sea left Philadelphia on September 5, 1986, sailed for more than two years along the west coast of Africa, and failed to find a place to dump its "cargo" (O'Leary and Walsh 1988, Munro 1988, and Tifft 1988).

Composting

Composting is another waste disposal alternative. Composting of municipal solid waste is defined as the biological decomposition of the putrescible components of the waste stream, to produce a stable end product which has value as a soil conditioner (Lidkea, 1987). This technique has always had the serious drawbacks of a high requirement for operating space and sparse markets for products. Furthermore, composting operations have the potential to pollute water and to produce objectionable odours (Lidkea, 1987). In addition, the compost may contain heavy metals which can be health hazards.

Recycling

Recycling is another option which offers perhaps the best hope of alleviating many problems associated with other waste disposal options. While recycling cannot totally eliminate a community's need for a landfill, a well-run and aggressive

recycling program can significantly reduce the volume of waste that must be landfilled. It can also help extend the life of existing disposal sites, so reducing the need for new landfills (Walsh and O'Leary, 1988a). Furthermore, it can help to change the way people think about their refuse, the way they consume, and the types of products they demand from industries and business (British Columbia Public Interest Research Group Newsletter, 1988). As a result of the growing social awareness of the problems posed by municipal solid waste disposal, many recycling activities and a good deal of research have been undertaken in different parts of the world (OECD, 1982; Peter and Grogan, 1988; Environmental Council of Alberta, 1981; Stone and Douglas, 1988).

2.2. Recycling of Municipal Solid Waste

2.2.1. Definition

Recycling is a much abused term. According to the Merriam-Webster Dictionary (1984), to recycle means "to recover useful material from or to use again instead of discarding". But a review of the literature on solid waste disposal shows that many different terms such as "reuse", "reclaim", "recycle" and "recover" have been used interchangeably, with the result that there is considerable confusion about the meaning of these terms. Free (1986) defined 'to recycle' as 'to treat or process used or waste materials by making them suitable for reuse'.

The Environment Council of Alberta (1979) distinguishes recycling from reusing and states that to recycle is to convert used materials into new products, whereas to reuse is to use another time; this latter term refers to items which can be used a number of times in the same form, such as bottles. The council puts forward, in its 1987 report entitled "Recycling of waste in Alberta: Technical Report and Recommendations," a four "r's" approach to waste management: reducing, reusing, recycling and recovery. According to this report, "recycling' can be defined as "the use of materials confined in products otherwise discarded as waste -- the materials are used in new products with a minimum of change to their basic nature" (Environment Council of Alberta, 1987:33). Recycling differs from reusing because it is not the product itself that is reused, but rather the material that makes up the product. Recycling also differs from recovery because it does not involve major modification of the material during its extraction from the product, as does, for example, the recovery of energy, or the recovery of oil through pyrolysis.

Webb (1985) argues that recycling has several meanings. In addition to the reprocessing of materials, recycling is used to mean reuse of manufactured products, and by-product generation from recovered materials. Returnable bottles are examples of reuse, while power generated from recovered incinerable materials is an example of by-product generation.

Adamson (1984) suggests that waste recycling includes: (a) the recovery and reuse of the waste into the same process that generated it (in-line recycling); (b) the transfer of waste from one industry to another for reuse in another industry's process (inter-industry exchange); and (c) waste recovery (the extraction of valuable materials in waste stream for reuse in other processes, either within or outside of the industry, with or without some form of treatment).

Porteous (1977) states that recycling, in fact, falls into three main classes, namely re-use, direct recycling and indirect recycling. Re-use is typified by the returnable bottle. It makes several trips from bottler to consumer and back again, where it is cleaned and refilled. Re-use may be allocated the highest availability in the recycling spectrum, in that the least energy and process complexity are expended in getting the material or article back into use. Direct recycling has an intermediate availability in that both energy expenditure and process complexity may be required in getting the material back into use. Using the returnable bottle as our example, once it is unfit for re-use, it may be cleaned and broken down for cullet, which is remelted at the glassworks and used to make new bottles. Direct recycling will be strongly influenced by the fact that some materials degrade in quality with continued reprocessing. Paper and plastics are two such examples. Indirect recycling often uses

the recycled material for a new purpose. Continuing with the glass bottle example, the bottle may be ground and used as a highly skid-resistant and durable road surfacing material. Other examples are the conversion of refuse to combustible gases by pyrolysis and district heating by means of incineration with heat recovery. Thus, a waste material may have several recycling possibilities and the choice of these will be dictated by the market for the commodity, or service, for which there is the greatest need.

To summarize, there are four basic ways to recycle consumer products: (a) reuse of a product for its original use; (b) reuse of a product in its original form for a new purpose; (c) reuse of the material for re-manufacture of the same material; (d) reuse of the material for a new purpose. For the purpose of this research, a general definition is taken to cover the entire scope of resource recycling from reuse of refillable containers to indirect recycling of some materials. However, energy recovery will not be included in the content of recycling in this research. Therefore, in the context of research project, recycling refers to: "the process by which useful materials are separated from municipal solid waste stream, then collected and processed for further reuse".

Recycling operations are by no means a new phenomenon. Many, such as scrap metal operations, have been in existence

for centuries. However, the recycling of post-consumer wastes has been a relatively recent event, growing out of the conservation movement of the late 60s and the early 70s. In most cases, these new recycling operations were privately run, receiving little or no government support. Many of these operations failed, due to the relatively labour intensive nature of the operations and low public participation. As a result, relatively small quantities of material were diverted from the post-consumer waste stream (Stone and Douglas, 1988). The landfill capacity crisis that emerged in the Northeast U.S. and other areas in the early 1980s has changed this situation. The recycling of municipal solid waste is no longer viewed by provincial, state and local governments as a profit making enterprise, but rather as a potential waste disposal method. If the net cost of recycling (that is, the collection cost minus the price of the collected materials) is less than the alternative disposal method, then it is also seen as an economically desirable disposal alternative (Stone and Douglas, 1988).

This new view of evaluating recycling has prompted a strong wave of recycling throughout the world. Different levels of governments have taken the initiative to promote recycling, and more and more communities are making recycling an important part of their waste management practice. For example, in the United States, The Senate Bill 1113, known as

The Waste Minimization and Control Act of 1989, establishes a goal of recycling 25 percent of national municipal solid waste within four years, and 50 percent within 10 years. Eighteen states in the country have also set specific recycling goals, and seven of these states are mandated by their legislation to achieve their specific goals. Many communities, such as Somerset and Essex, New Jersey have developed voluntary recycling projects. Others, including Wilton, New Jersey; Islip, New York; and Madison, Wisconsin, have set up mandatory recycling programs. In Canada, the significance of recycling has also been recognized. Several provinces such as Ontario, Alberta and British Columbia have developed recycling plans to deal with their waste problems. Many communities, such as Kitchener, Mississauga and Hornby Island, have also developed various recycling projects. These programs are significantly reducing waste volumes entering landfills and are conserving valuable resources.

2.2.2. Benefits and Barriers of Recycling

Why should we recycle? What is hindering us from achieving a higher recycling rate in our society? A discussion of the benefits and barriers of recycling may help to answer these questions. This section will review the literature on the benefits and barriers of recycling, providing a basis for comparison for the results derived from the author's questionnaire.

2.2.2.1. Benefits

For individual municipalities and businesses, and for society as a whole, there are numerous environmental and economic benefits to be gained from the recycling of municipal solid waste (Ontario Waste Management Advisory Board, 1980). Many authors have discussed the various benefits of recycling municipal solid waste. These include: (a) conservation of natural resources; (b) reduction of waste volumes, and therefore reduction of conflict amongst groups over locations of new landfills; (c) diminished pollution; (d) financial gain; (e) job creation; and (f) support for charitable groups.

Conservation of natural resources

Free (1986) and Glysson et al (1972) have pointed out that conservation of natural resources is often cited as the principal reason for recycling. Free further argued that conservation of natural resources as a primary benefit has been established by several surveys conducted in Oregon, Washington, Quebec and British Columbia. The Environment Council of Alberta (1987) and the Ontario Waste Management Advisory Board (1980) also reported that increased recycling will reduce the tremendous waste of resources and energy that burying vast quantities of useful material represents. According to the U.S. Final Report of the National Commission on Materials Policy (1973), about 2 percent of the total U.S. energy demand could be saved by the recycling of available

steel, aluminium and paper (Smith, 1976). The Environment Council of Alberta (1979) reported that aluminium can be recycled at a saving of 95 percent of the energy used to manufacture the metal from bauxite. Rompre (1980) has assessed the potential energy savings in B.C. from recycling 106,000 tonnes/year of paper, glass and tin cans at \$1.9 million/year (Stanley Associates Engineering Ltd., 1981). Walsh and O'Leary (1988a) estimated that recycling one tonne of newspaper saves the equivalent of 19 trees. Considering the depletion of some natural resources, particularly scarce non-renewable mineral resources, this consideration becomes even more important. For the countries which depend on imported primary materials, the use of recycled materials has a favourable influence on a country's balance of payments, which may, in turn, have political implications (OECD, 1983).

Reduction of waste volume

The Environment Council of Alberta (1987), The Ontario Waste Management Advisory Board (1980), and Glysson (1972) have pointed out that recycling is able to reduce municipal solid waste volume and therefore, to conserve landfill space for materials that cannot be disposed of in any other way. Obviously, the more materials that can be extracted from the flow of municipal solid waste headed towards final disposal, the smaller the flow becomes, so pressure to secure new disposal sites becomes less intense. An overall potential

maximum weight and volume reduction of 15 percent to 20 percent of the amount to be landfilled was estimated in the United States and Europe as a result of recycling (C.R.D. Solid Waste Management Subcommittee, 1986). The CBC Morning news reported on December 26, 1987, that recycling is considered to be one of the best solutions to the problem of municipal solid waste, in Toronto, where a 15 to 16 percent reduction of waste volume could be achieved through recycling.

Another major benefit is that the volume of waste from recycling is a fraction of the original waste material and the residue is of a known and uniform quality, making further treatment or disposal easier. That is, recycling simplifies the waste which must be sent to landfills. Savings on collection, hauling and disposal costs have also been discussed, but this topic is rather controversial. Stanley Associates Engineering Ltd. (1981), for example, estimates that recycling may result in a saving of \$21.00/tonne in labour and equipments, and \$17.00/tonne in collection and disposal land respectively. However, some researchers argue that recycling is not economically viable. For instance, Lidkea (1987) claims that recycling cannot be supported by economic analysis alone. He believes that the cost of wages, rent, vehicles, maintenance and repair, utilities, freight, insurance and advertising generally outweigh the value of the recycled material, plus the saving involved in diverting materials from

the regular collection, hauling and disposal system.

Reduced pollution

Another powerful argument in favour of recycling is that it reduces water, air and soil pollution by using recycled instead of virgin materials. Rattray (1981) has claimed that reprocessing waste paper achieves a 25 percent reduction in water pollution, and a 73 percent reduction in air emission control costs. In the United States, the Environmental Control Agency has estimated the savings on water and air pollution control costs, achieved through recycling paper, at \$4.00/tonne and \$25.00/tonne respectively (Stanley Associates Engineering Ltd., 1981). Walsh and O'Leary (1988a) also reported that air and water pollution are reduced in many instances when recycled materials are used in manufacturing processes (Table 2.2).

Table 2.2: Saving from Manufacturing Products Using Secondary Materials

	Paper	Glass	Steel	Aluminum
Energy	23-70%	4-22%	47-74%	92-97%
Air pollution	74%	20%	86%	95%
Water pollution	35%		76%	97%
Mining waste		80%	97%	
Water use	58%	50%	40%	

Source: Walsh and O'Leary. (1988a)

Financial Gain

Financial gain as a benefit of recycling is another extremely controversial issue. Many authors (Environment Council of Alberta, 1987; Gravelines, 1985, and Dalton, 1973) have recognized it as a major reason why people recycle, but its importance as a motive to recycle is ranked quite differently by various researchers. Some even appear to contradict themselves. Free (1986), for example, said that numerous surveys have shown that economic rewards, or reduction in personal costs, have only a moderate influence on a person's decision to recycle. However, he then stated that monetary incentives can increase recycling rates substantially. Dalton (1973) put forward a different argument, suggesting that financial gain by itself provides a sufficient incentive to greatly extend recycling activities. Environmental Resource Ltd. (1985) presented a similar argument. According to this organization, recycling in the long run only takes place when the financial benefits gained by the manufacturers and other users, or exporters, of the recovered material exceed their costs.

Job creation

Recycling operations are very labour intensive and generally employ handicapped and unskilled workers, who are normally most susceptible to unemployment. It has been estimated that 203 additional jobs were created through the

provision of province wide source separation recycling in B.C. (Stanley Associates Engineering Ltd., 1981). Some studies contend that recycling creates approximately five time as many jobs as would be created by landfilling the equivalent quantity of waste. The OECD (1983) also mentioned this benefit of recycling.

Support for charitable groups

Charitable benefits are also offered as a reason for recycling. Free (1986) reported that, in Vancouver, a large majority of survey respondents expressed a willingness to save newspapers for a local charitable group.

In addition, increased awareness of environmental problems can lead to the development of an environmental ethics in the community. Certainly a well-run and successful recycling program is usually viewed as a major source of community pride and progressiveness (Walsh and O'Leary, 1988c).

2.2.2.2. Barriers

Despite the benefits of recycling, its use in our society is very low. What is holding us back? Many economic, institutional, technological and societal factors appear to be barriers, limiting recycling activities.

Economic barriers

Our economic system is not used to large-scale conservation practices, particularly recycling. It has promoted the throwaway principle engendered by underpriced energy and raw materials and an environment that has been taken for granted and considered virtually free for everyone to pollute. Our economic system gives depletion allowances to developers of virgin resources and charges more to transport recycled resources than new ones (Purcell, 1980). As discussed earlier, recycling in the long run only takes place when the financial benefits gained exceed the cost. The relatively higher cost of recycling and reprocessing secondary material therefore, is a crucial factor in hindering our society from adopting a higher recycling rate.

The economic constraints on recycling are obviously reflected in the market for recyclable materials and the process of collecting, transporting and reprocessing them. Regardless of the motivation behind a potential program, there must be a market (or other appropriate end use) for the material recovered. Without a useful end product, no program can survive for long. An evaluation of markets indicates that some are very limited, or highly vulnerable to fluctuations, while others may be quite strong when there is a limited supply of recycled material, but would weaken dramatically if everybody were participating and supply rapidly increased

(Lower Mainland Refuse Project Concepts Report, 1984).

The U.S. Environmental Protection Agency, in its 1979 report to the U.S. Congress, has offered a discussion on the factors contributing to the limited response to the use of recycled materials. Firstly, natural resources occur in concentrated forms, whereas recycled secondary material from waste is dispersed widely and has attendant high collection costs. Secondly, manufacturing costs from secondary materials are as high as, or often higher than, those from virgin materials. Consequently, only high quality materials can find a ready market and artificial factors often favour the use of virgin materials (Holmes, 1981). Where recycling site and market are widely separated, the resultant high transportation costs also become a deterrent to recycling (Stanley Associates Engineering Ltd., 1981; U.S. National Centre for Resource Recovery Inc., 1974).

Institutional barriers

The relatively high cost of accumulating and remanufacturing recyclable materials accounts for some of our failure to recycle many commodities. However, institutional factors, which do not price goods and raw materials at the full social cost, are probably at least as responsible for the failure of more recyclable material to be exchanged in the marketplace (Webb, 1985; Glysson et al, 1972).

Our society has not been a recycling one in the past, and institutional inertia works against changing that situation. Since most existing recycling operations cannot demonstrate a direct economic profit for their operation, the traditional financial institutions will not provide capital to purchase equipment and facilities necessary for recycling operations. It is more profitable for them to choose the cheapest and most convenient materials at hand. Any departure from this approach is contradictory to the management tradition of our society; and, as a consequence, industries are very reluctant to change to recycling. Government policies have historically played a major role in stimulating natural resource development. Currently special tax laws relating to mining and forestry and federal subsidies for raw material exploration, research, and development all favour raw materials and encourage a materials-intensive economy. A number of laws and policies tend to discriminate against recycled materials and waste reduction measures. For instance, the mining industries typically receive subsidies and tax advantages, while the recycling industries seldom receive such support. Furthermore, historical disregard for environmental degradation and current low pollution control standards, undercosting and non-charging for waste management services, and the lack of legislative schemes to promote recycling have all slowed down, or prevented progress in recycling (Mechler, 1980; Adamson, 1983).

Technological barriers

Waste materials are a mixture of many elements, compounds and contaminants which make economic sorting and processing very difficult, and sometimes impossible. Principal process technologies are designed to use virgin materials, while recycling waste often requires different technology which is very expensive. Even when the technology exists to separate useful materials from municipal solid waste, recycling costs are often high, thus reducing the feasibility of recycling (Purcell, 1980; and Holmes, 1981).

Societal barriers

Societal barriers can be crucial in hindering successful recycling. These include prejudice against municipal solid waste and waste management, the desire for new products and an associated resistance to recycled products, and the throwaway habit. The Environment Council of Alberta (1987) and Free (1986) have suggested that the social attitudes of individuals, and of society as a whole, greatly affect public participation. They have found that inconvenience and trouble were identified by the public as the most common objections to recycling. This convenience-oriented attitude has to change, if a higher recycling rate is to be achieved. In addition, unstable recyclable supplies and a lack of both information and awareness are also barriers to recycling.

2.3. Recyclable Materials and Recycling Rate

This section examines what and how much material is recycled in different programs and it is hoped that the results will provide a baseline to evaluate the Hornby Island recycling program. Studies undertaken in Canada and other parts of the world have shown that many varied materials are being recycled (Table 2.3). However the most common materials involved are paper and cardboard, glass and "tin cans" (Environment Council of Alberta, 1987, 1986, 1979; OECD, 1983; and Ontario Waste Management Advisory Board, 1980).

Table 2.3: Recyclable Materials

Motor oil
Glass bottles
Scrap metals
Tin cans
ferrous scrap
Aluminum
Other nonferrous scrap
Waste paper
Old newspaper
Old corrugated containers
High-grade office paper

Source: After the City of Portland (1986)

Table 2.4. based on data given in Table 2.1 illustrates the average composition of municipal solid waste. Clearly, there is a strong physical presence (that is, the total amount of a particular material entering the solid waste stream) of

recyclable materials, but actual availability for recycling is substantially less, because of inevitable losses and excessive mixing.

Table 2.4: Physical Presence of Municipal Solid Waste

Material	Percentage
Paper and cardboard	20-50%
Metals	4-11%
Glass	5-13%
Plastic materials	3-11%
Organic materials	22-43.2%
Textiles and wood	2.2-8.6%

Source: OECD, 1983.

Estimates of the potential availability of recyclable materials in the municipal waste stream vary, but on average it would appear that over 90 percent of the waste glass is available for recycling, and 70 percent represents a reasonable figure for textiles and ferrous materials. Losses are higher for paper and cardboard and potential availability estimates range from a low minimum estimate of 25 percent, up to a maximum of 60 percent. Aluminium is consistently ranked at the bottom of the potential availability ranking order with a figure of 30 percent (OECD, 1983).

The current recycling rate also varies widely. It was reported that 7 percent by weight of solid waste generated, in

the Lower Mainland of British Columbia, was recycled in 1984. It was further estimated that implementation of an area-wide curbside pick-up program could increase this recycled fraction to 11 percent (The C.R.D. Waste Management Subcommittee, 1986). Mississauga, Ontario, which recycles newspaper, glass, tin and aluminum containers, estimates an 11 per cent reduction in its residential waste (Glenn, 1988b).

Studies of voluntary and mandatory recycling programs, in municipalities in the United States, were carried out by Glenn (1988b) and Peters and Grogan (1988). Glenn (1988b) reported that Groton, Connecticut, which collects newspaper, glass, tin and aluminum containers, corrugated cardboard and aluminum foil, estimates a 25 percent diversion of its residential waste. Hamburg, New York claims that 34 percent of its residential waste is recycled. Peters and Grogan (1988) surveyed over 20 different programs of all sizes and types in the United States. Data on the proportion of the community participating in recycling, the percentage of waste diverted from final disposal, and kilograms per person being recycled were estimated and are presented in Table 2.5.

Table 2.5: Summary of Recycling Programs (Peters and Grogan 1988)

City	Estimated Population served	Percentage waste diverted	Percentage participation	Estimated Amount recovered (KG/capita/year)	Start date	Materials Collected ¹
Wilton, NH	8,500	44%	65%	272	1979	Everything
Madison, WI	143,000	6%	75%	23	1968	NP, AP, YW
Prairie du Sac, WI	2,300	30-50%	95%	114	unknown	Everything
Montclair, NJ	38,000	23%	75-85%	107	1971	NP, AL, GL, YW, AP.
Islip, NY	300,000	6%	50%	unknown	1980	Everything
Mecklenburg County, NJ	22,500	unknown	70%	52	1984	YW, MO, NP, OP, GL, AL,
Marin County, CA	255,000	22%	60%	87	1981	OCC NP, AL, GL, MM, MO,
Somerset County, NJ	81,000	23%	unknown	unknown		
Essex county, NJ	850,000	15-20%	unknown	114	unknown	NP, AL, GL, YW, AP.
San Jose, CA	400,000	5%	58%	52	1985	GL, NP, AL, YW.
Kitchener, ON	250,000	12%	84%	41	1983	NP, GL, AL, MM, MO, AP.
Santa Monica, CA	90,000	unknown	28%	20	1985	NP, GL, AZ, MM, MO, OCC.
Austin, TX	115,000	4%	20-25%	250	1982	NP, GL, AZ, MM.
Minneapolis, MN	270,000	11%	20-25%	25	1982	NP, GL, AL.
Ann Arbor, MI	54,000	10%	25-50%	43	1978	AL, GL, NP, MO.
Naperville, IL	39,000	unknown	35-40%	unknown	unknown	NP, GL, AL, PL.
Omaha, NE	250,000	unknown	unknown	unknown	1988	NP.
Portland, OR	450,000	24%	20%	34	1987	Everything
Champaign, IL	31,000	unknown	65%	59	1986	NP, GL, AL.
Urbana, IL	10,300	unknown	65%	50	1986	NP, GL, AL.

¹ NP - glass, AL - aluminum OCC - old corrugated cardboard OP - office paper YW - yard waste,
 PL - plastics, MO - motor oil MM - mixed metals AP - appliances AB - auto batteries
 MP - mixed paper

2.2.4. Recycling Techniques

2.2.4.1. Mandatory vs. Voluntary Programs

There are two basic types of recycling programs: mandatory and voluntary programs. The decision by a community either to make recycling mandatory, or voluntary, is usually driven by economic realities, such as diminishing and costly landfill space and/or increased distances to available disposal sites (Peters and Grogan, 1988). Most of the current mandatory programs are found in the United States. With available landfill space becoming a premium in many areas in that country, mandatory recycling is increasingly promoted as the best way to address current solid waste problems. Recent data confirm that this method achieves a better public participation rate and volume recovery rate than voluntary recycling. Most of the mandatory programs surveyed by Peters and Grogan (1988) had a participation rate of at least 65 percent, and volume recovery rates of about 93 kilograms per person per year.

Communities considering mandatory recycling need to think carefully, for enacting a mandatory program alone will not necessarily win both community support and high participation rates. On the contrary, there will always be opposition, since a mandatory program, by definition, is coercive and requires people to change long-held habits. Therefore, a

mandatory program, if it to be successful, must be carefully planned, and publicity and education must be used to inform the public about the program's benefits.

Voluntary programs can take many forms, ranging from youth groups recycling newspapers at a drop-off centre to a city-wide recycling program. Voluntary programs, when well designed, can yield high recycling rates and develop citizen enthusiasm. The implementation of an effective recycling program can benefit a community in many ways, resulting in cost savings, reduced environmental impact, and enhanced community spirit (O'Leary and Walsh, 1988b). To succeed, voluntary programs must encourage participation by offering convenience and reliable operation. Incentive and peer pressure, if cleverly structured, can also promote participation (O'Leary and Walsh, 1988b).

2.2.4.2. Separation

It has already been argued that increased recycling is in the best interest of society, and must be accepted as a primary goal of all effective solid waste programs. The most serious technological constraint that keeps us from reaching this goal stems from the fact that the usability of raw materials depends on their purity. Therefore separating waste becomes the most important key to recycling, because it makes salvage on an economic scale feasible.

There are three places where recyclable can be separated from the waste stream: in the home (or at-source), at the curb, or at a processing facility. Most of the long standing recycling programs have relied on residents to do the bulk of separation in the home (Glenn, 1988b). The Environment Council of Alberta (1987) has examined the characteristics of at-source separation and central processing; the advantages and disadvantages of each are presented below (Table 2.6). They commented that the advantages of at-source separation make it much more attractive.

Table 2.6: Comparison of at-source Separation and Central Processing of Mixed Waste

At-source separation	Central Processing
Great responsibility placed on waste generator	Little responsibility placed on waste generator
Often requires promotion	Little promotion needed
Low technology involved	More technology involved
Moderate capital investment	High capital cost
Labour intensive	Limited labour
High quality products	Low-quality products
Large volunteer component	Mostly paid labour
Flexible	Relatively inflexible
Good track record	Questionable track record

- Note: 1) at-source separation refers to the process that diverts recyclable from the waste stream before it becomes mixed with other materials and collected for disposal.
- 2) central processing refers to the process that separates commingled materials at a central facility.

Source: Environment Council of Alberta (1987)

At-source separation is experiencing growing popularity. The Environment Council of Alberta (1987) views it as the better strategy for material reuse and recycling. Free(1986) also points out that at-source separation is often desirable because the quality of the recovered material is more easily maintained. However, it requires special effort by individual waste generators to separate their waste into the desired components, such as paper, glass, metal, and other refuse. The materials must also be stored separately until they can be collected. As the number of materials collected increases, some in recycling believe that requiring fine separation reduces participation (Glenn, 1988b).

Curbside separation is a recycling method that lies between the two mentioned above. Perhaps the best known program that separates at the curb is operated by Laidlaw Industries in Kitchener and Mississauga, Ontario. The blue box recycling program of the Capital Regional District, B. C., is another example of curbside separation. There, a crew sorts material at each stop at the curb. While separation at the curb may help participation, it tends to slow down collection and hence increases the cost.

2.2.4.3. Collection

Collection methods vary according to the nature of the recyclable materials and the nature of the targeted sources, as well as the experience and resources available to the collectors. Many forms of gathering recyclable materials are used, including drives, drop-off depots, supervised drop-off and curbside collection. Comparing these collection methods, supervised drop-off and curbside collection seem to be the most common collection techniques.

Supervised drop-off involves a central depot, where large containers are placed and people can leave their recycled materials at their convenience. Supervisors of the drop-off usually offer assistance to recyclers and manage the operation. Drop-off has long served as the backbone of the recycling system in many communities. The relative cost of providing drop-off services is much less than providing home collection (Glenn, 1988b). Drop-off is particularly practical for small communities.

Curbside collection is a program in which residents separate and store materials, then set them out at curbside on collection day. The materials are collected and delivered to a central depot, or to a market by a common service, often associated with refuse collection. This technique has many

advantages. The quality of the materials collected is generally good and the convenience of the technique attracts high participation rates and develops the recycling habit. This technique is gaining popularity throughout North America (Powell, 1984).

In summary, the recycling of municipal solid waste has recently become a global environmental issue. Faced with the problems associated with escalating quantities of solid waste and the serious weakness of current landfill practices, our society has been searching for alternative solutions. Recycling may offer the best alternative to current practices.

There are, of course, arguments for and against recycling. Although some authors present conservation of natural resources, reduced waste volume, less pollution and financial gain as the major benefits of recycling, others tend to view the their relative importance of these characteristics quite differently. It is clear that reduced waste volume and financial gain are, perhaps, the most attractive benefits, because the realistic purpose of waste management is to "get rid of" the solid waste in a financially viable way. Barriers to recycling, which result in a low level of participation, are mostly of social origin. Although economic viability seems to be the most crucial of these factors, it is heavily influenced and, to some degree, determined by institutional

and societal barriers. Technological factors mainly affect financial feasibility.

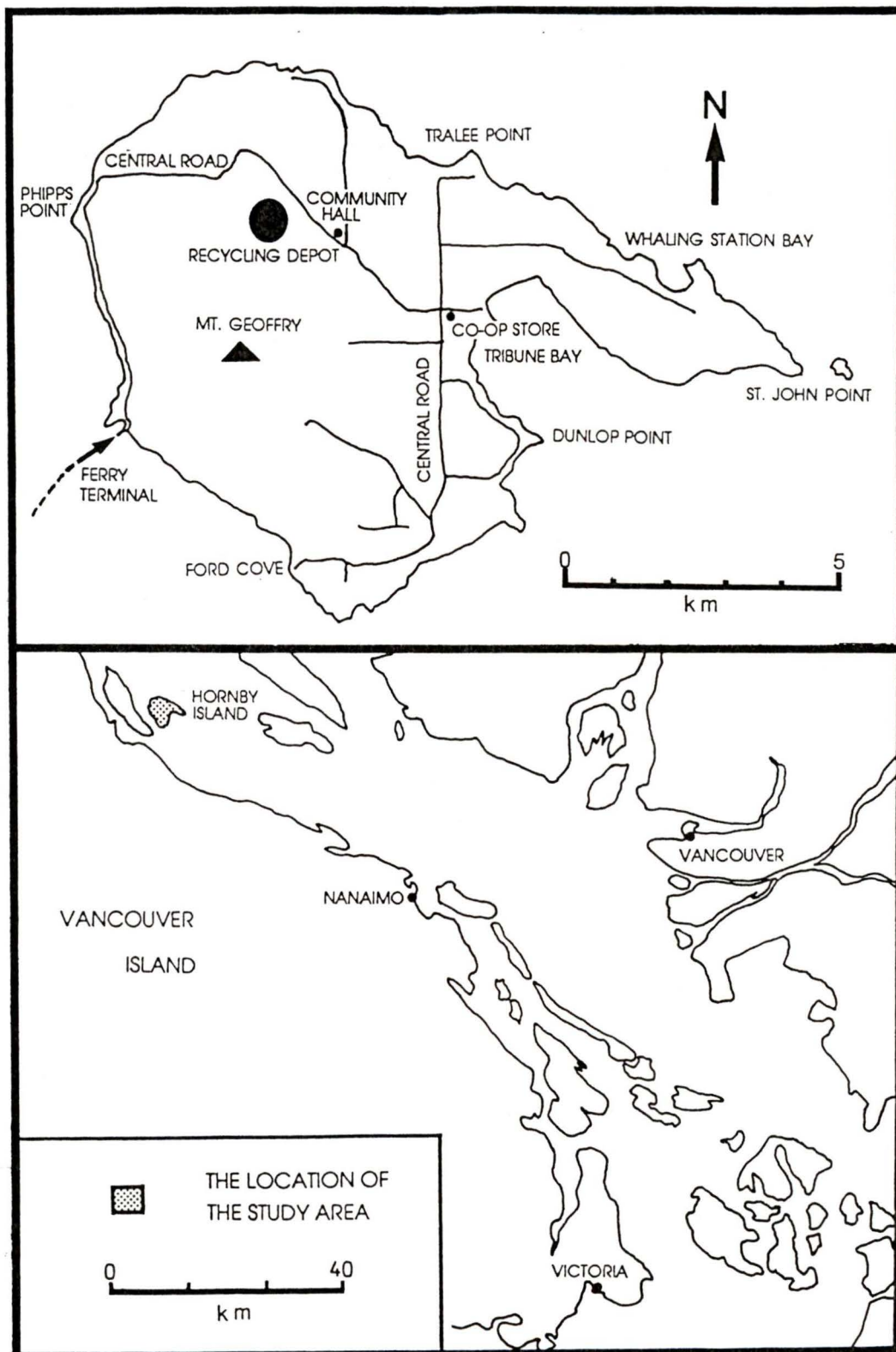
Clearly, a large volume of recyclable materials exists in the waste stream. Recycling, therefore, has great potential for development. Through assessment of different recycling techniques presented in this chapter, it appears that for small communities, a feasible technique is the low technology approach, which is typified by source-separation and supervised drop-off depot. Public participation is, therefore, very important to the success of such a recycling program, and tends to be improved by financial incentives and legislative requirements.

Chapter 3

**THE SELECTION OF THE HORNBY ISLAND RECYCLING PROGRAM
AS A CASE STUDY****3.1. GENERAL BACKGROUND OF THE HORNBY ISLAND RECYCLING PROGRAM**

Hornby Island is situated off the east coast of Vancouver Island, some 30 kilometres southeast of Courtenay (Figure 3.1). It has an area of about 30 square kilometres (12 square miles) and a population of 1,000 permanent residents with an estimated additional 4,000 to 5,000 seasonal residents and visitors in the summer (Fletcher, 1989). Before 1978, municipal solid waste was dumped on the island, at the site, where the recycling depot is now located (Figure 3.1). This dumpsite was identified as a source of potential water contamination, and the process was stopped, in 1976, by the Waste Management Branch of the B. C. Ministry of Environment. In order to avoid trucking the solid waste off the island to Pigeon Lake at Cumberland 65 kilometres (or 40 miles) away, at a cost of around \$85,000 a year, the community initiated a recycling program. Since then, it has developed into an islandwide program, which has successfully handled its municipal solid waste at a reasonable cost and helped to protect the environment.

Figure 3.1: Location of the Case Study



When first visiting the island as a tourist in 1987, the author was deeply impressed by the success and uniqueness of its recycling program. The recycling program enjoyed a very high public participation rate. According to Robert Philips, Chairman of the Hornby Island Recycling Committee at that time, municipal solid waste was a concern for the whole community, and every household participated in recycling activities. Hornby Islanders were very proud of themselves for recycling their solid waste.

The recycling program was largely a voluntary effort. Except for one full-time operator and two or three part-time assistants, hired by the community to manage the recycling depot, the program was run by volunteers. Since the program was characterized by comprehensive multi-material recycling, it was different from those of many other areas which, although run by volunteers, generally focused on single material recycling such as paper, bottles or tin-cans. On Hornby Island, every resident was asked to cooperate by separating their solid waste and taking the sorted materials to the depot. At the depot, all metals and glass were further processed and sold for the cost of trucking to the market. All worthwhile clothing, footwear and household articles were reclaimed and reused, plastics were accumulated for future disposal and the rest of the waste stream was burnt.

This recycling program also generated some very interesting innovations, as exemplified by the free store. The free store is a "goodwill-kind" of operation, located at the recycling depot, where volunteers sorted and stocked useful items such as footwear, clothing and household appliances from the refuse brought in by local residents and summer visitors. Once these items were put into the store, everyone could take away anything, free of charge, for his or her own use. The store has not only given the community a resource and worthwhile service but also demonstrated an invaluable goodwill that lies at the heart of people willing to make recycling a permanent feature of the island (Philips, 1988).

Despite the wave of recycling that was taking shape in North America in 1987, very little research had been undertaken on small community recycling. The urgent need for more insight in this area and the successful experience of the Hornby Island recycling program provided the motivation from which this research project emerged.

3.2. RATIONALE FOR CHOOSING THE HORNBY ISLAND RECYCLING PROGRAM AS A CASE STUDY

The Hornby Island recycling program was chosen as a case study for several reasons. First, Hornby Island's experience may have some practical implications for waste management in many other small communities. Contrary to the failure of most recycling programs that grew out of the conservation movement in the late 60s and early 70s, the Hornby Island recycling program has successfully survived. Several island communities in the Capital Regional District share many characteristics with Hornby Island, because of their isolated geographical locations and municipal solid waste management problems. By examining how the Hornby Island recycling program developed and why it is so successful, these communities might develop effective recycling programs of their own. Considering the fact that over 70 percent of the municipalities in Canada are small, with populations below 2,000 (Statistics Canada, 1986), such programs could have a far-reaching impact. In addition, the evaluation process may also help Hornby Island better appreciate its own recycling project, and may lead to further improvements in waste management practices on the island.

Evaluation of the Hornby Island project may also provide a baseline from which to assess other community recycling programs. The literature review showed that no systematic study had been undertaken of waste management in small

communities. The program on Hornby Island was said to be successful, but a systematic evaluation must be undertaken in order to fully determine this objectively. This research was designed to examine (a) the materials being recycled; (b) the amount being recycled; (c) the financial feasibility of the program; and (d) the public participation rate, as well as (e) additional factors. Research results may form a basis for comparison with other islands, such as those where the Capital Regional District is responsible for municipal solid waste disposal.

Evaluation of the Hornby Island recycling project can also make a contribution to our understanding of innovation. Innovation passes through a series of phases, beginning with invention or discovery and continuing through successive steps during which more and more of the potential adopters decide to join those accepting it in the initial stage (Foster and Sewell, 1977). As might be expected, distinct individuals and groups usually have varying attitudes towards any innovation, adopt the innovation at different stages and play distinct roles in the diffusion process. Examining this process, and the factors which condition the rate of diffusion, may help the further development of the Hornby Island recycling program, while simultaneously contributing to our understanding of innovation process.

A questionnaire survey may contribute to our knowledge of public attitudes and behaviour towards recycling. Many authors recognize the importance of public participation in recycling. Purcell (1980) sets forth the view that individual Americans, as citizens and consumers, can have a direct bearing on the critical issue of resource use, and consequently, on the survival of this planet. He points out that tremendous cooperation from everyone in our society will be required if waste reduction and recycling are to live up to their potentials. The Environmental Council of Alberta (1979) argues that the interest and participation of citizens will play a major role in making recycling possible in Alberta. The Eighth Canadian Waste Management Conference in Halifax (1986), Free (1986), and the Ontario Waste Management Advisory Board (1980) also noted that the success of recycling depends on the participation and support of individuals. Experiences in many communities such as Portland, Oregon, have also indicated that operation costs per tonne decline as participation rates increase (OECD, 1983; and City of Portland, 1986).

Although some studies have shown a lack of correlation between expressed attitudes and overt behaviours, positive correlation between the two has often been observed (Free, 1986). Favourable public attitudes towards recycling, recycled material and recyclable products may enormously

influence recycling activities. Therefore, examination of public attitudes may help determine incentives and barriers to increased participation in recycling. This may help delineate the major factors which affect recycling behaviour.

Chapter 4

THEORETICAL FRAMEWORK AND RESEARCH DESIGN

The previous chapters have established that while municipal solid waste has become a global issue, recycling may offer some hope of reducing the scale of the problem. They have also demonstrated that the evaluation of the Hornby Island recycling program may help improve recycling both on the island itself and in the other small communities. It may also contribute to geographical theory. This chapter attempts to design a methodology suitable for an evaluation of the Hornby Island recycling program. It begins by reviewing the literature on innovation diffusion, thought to be relevant to this research project, and then proposes a research design.

4.1. DIFFUSION OF INNOVATION: A THEORETICAL FRAMEWORK

Diffusion of innovation has been the subject of geographic enquiry for several decades, since the spread of a phenomenon, idea or technique throughout a population, or region, incorporates basic geographic elements of distance, direction and spatial variation, and thus forms a valid field of geographic interests (Brown, 1981). While geographers have studied diffusion throughout most of the twentieth century, the focus of this effort has shifted over time. As a result, numerous studies have been carried out, and various

descriptive and normative models have been provided to examine the diffusion processes. Some of these studies have been concerned with explaining diffusion from the viewpoint of individual adoption behaviour, and others have focused on organizational behaviours (Foster and Sewell, 1977; and Hudson, 1972). Studies undertaken by Hagerstrand (1952, 1967), Rogers and Shoemaker (1971) and Brown and Moore (1969) are only a few examples of the former, the latter being illustrated by the research of Brown (1968, 1975), Pedersen (1970), Gross and Shreatha, et al.(1974), and Hanham (1973). While some authors such as Hagerstrand (1952), Morrill (1968, 1970), Berry (1972), Hudson (1969) and Wood (1970) focused on defining spatial trends, or stages in diffusion with respect to centres in space, others concentrated on the diffusion process (Rogers, 1962; Robertson, 1971; Zaltman and Brooker, 1971; and Foster and Sewell, 1977).

An extensive review of previous research in this field will not be provided here, since several are already available (Scherer, 1984; Brown, 1981; Davis, 1979; Rogers and Adhikarya, 1979; Blaut, 1977; Hudson, 1972; Brown and Moore, 1969; and Morrill, 1968, 1970). What is important to point out here is that Rogers (1986) notices that research into the innovation process has begun to shift from highly structured and quantitative methods of investigating diffusion behaviours to more qualitative, more-in-depth and hypothesis-generating

case studies of the innovation process in organization. Emphasis here is placed on a conceptualization of the process of diffusion of community innovations, which is more pertinent to the present study.

4.1.1. Community innovation

The term diffusion of innovation often varies in meaning with the context of the research. For the analysis of municipal solid waste recycling, a community innovation is broadly defined here 'as an idea, practice, technique or product perceived as new by a community'. In this context, 'diffusion' refers to 'the process by which innovation spreads to the members of a social system' (Rogers and Shoemaker, 1971:12). Agnew, Brown and Herr (1978) studied the diffusion of community innovations and pointed out that the crucial factor in the diffusion of a community innovation is the decision of a local governing body either to establish an administrative agency associated with the innovation, or to implement the innovation through an existing agency. They also argued that the ability, or willingness, of the local government to respond to a central propagator's (for example, a state or federal government) promotion, or to initiate the adoption process on its own, is another important determinant of the diffusion of community innovation. A further

significant factor for both community innovation with a central propagator and those without, is the NEED for the innovation.

Foster and Sewell (1977) argued that the adoption of innovation by a community is greatly affected by its social context and indeed cannot be separated from it. This process is profoundly affected by such factors as cultural setting, the stage of economic development, level of technological progress, industrial structure, and the nature of political institutions. This discussion is directly related to the concept of 'innovativeness of a community'.

According to Kemp (1982), considerable research energy has been spent attempting to discover the key ingredients affecting the innovativeness of organizations, but each study appears to discover or reject different parameters. However, he found that the influences seem to have three dimensions:

(1) the need, or incentives, for innovation, (2) the mechanisms for bringing innovative alternatives into the decision making process and (3) the absence of organizational barriers to implementation (Kemp, 1982:24).

In spite of differences of opinion, this may serve as a general guideline in the analysis of the key factors which affected the diffusion of recycling on Hornby Island.

4.1.2. Diffusion Process

In the last decade, an important advance in diffusion research has been the exploration of the innovation process with respect to organizations, that is, studies which seek to understand how organizations decide to adopt and implement innovation. Since the concern here is with community innovation diffusion, this analysis focuses on the theoretical models that have been devised to analyze the process.

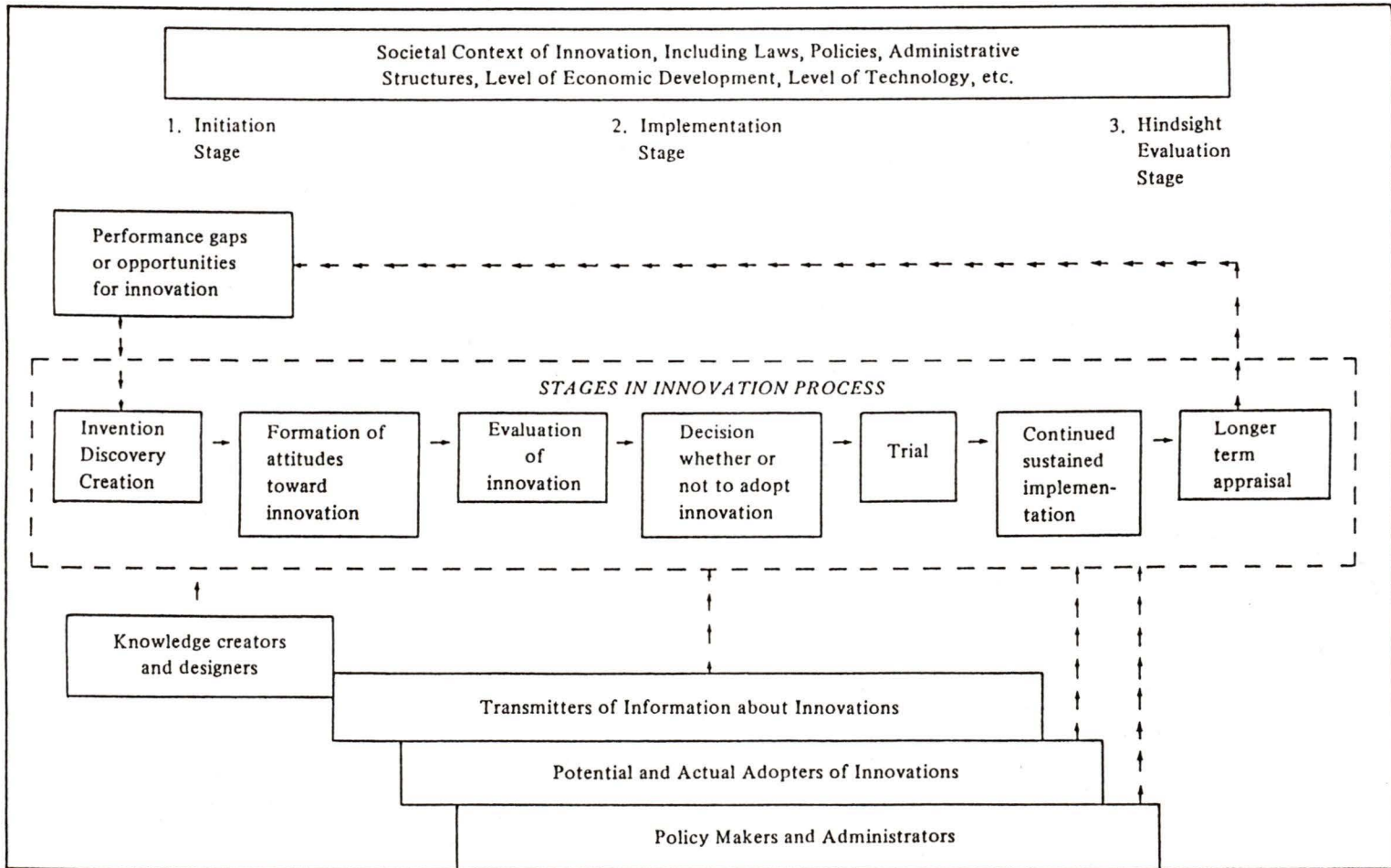
Theoretically, the process of innovation passes through a series of phases (or stages) beginning with invention or discovery and continuing through successive steps during which more and more of the potential adopters decide to join those who accepted it in the initial stage (Foster and Sewell, 1977). Foster and Sewell (1977), in their study, Solar Home Heating in Canada, summarised different models and identified three major stages in the innovation process: namely initiation, implementation and hindsight evaluation. Each of these consisted of a series of substages (Table 4.1 and Figure 4.1). Although Foster and Sewell's model emphasizes individual-oriented innovation processes, its concept in general, and the stage of hindsight evaluation in particular, will have relevance in studying community innovation process.

Table 4.1: Summary of Organizational Oriented Models of Innovation Process

MILO (1971)	SHEPARD (1967)	ZALTMAN, DUNCAN & HOLBEK (1973)
1. Conceptualization	1. Idea Generation	I. Initiation Stage
2. Tentative Adoption	2. Adoption	1. Knowledge-awareness substage
3. Resource Getting	3. Implementation	2. Formation of attitudes towards the innovation substage
4. Implementation		3. Decision substage
5. Institutionalization		II. Implementation Stage
		1. Initial implementation substage
		2. Continued-sustained implementation substage
WILSON (1966)	HAGE & AIKEN (1970)	
1. Conception of the Change	1. Evaluation	
2. Proposing of Change	2. Initiation	
3. Adoption and Implementation	3. Implementation	
	4. Routinization	

After: Foster and Sewell (1977), and Zaltman, Duncan & Holbek (1973).

Figure 4.1: Schematic Representation of the Innovation Process
 (Note: Only the major links and feedback loops are shown)



Source: Foster and Sewell. 1977.

Rogers and Adhikarya (1979) suggested that the innovation process consists of problem recognition, searching for alternative solutions, matching the innovation with the organization's problem, and implementation of the innovation. This eventually leads to its institutionalization, when it is no longer recognized as a separate element in the organization. Rogers (1986:138) further suggests that innovation process, in organizations, is usually considered successful if it leads to implementation (including institutionalization of the new idea), not just to the adoption decision per se.

Both of these approaches appear to be rational and a combination of them, where the process begins with Rogers' five stages and concludes with the hindsight evaluation stage suggested by Foster and Sewell, seems particularly applicable to this study. Since the actors (individual or organization) need to assess the innovation and make a decision concerning continued utilization in the present form, modification, and abandonment of the innovation, after it has been widely adopted (Foster and Sewell, 1977), the addition of hindsight evaluation seems reasonable. Based on the general concepts proposed by Rogers and Adhikarya (1979), Foster and Sewell (1977) and others, Figure 4.2 has been specifically designed by the author for use in the evaluation of the Hornby Island recycling program. When applying this model, particular

Figure 4.2. The Model of Diffusion Process to Be Used in the Case Study



After: Foster and Sewell, 1977; Kemp, 1982; Rogers and Adhikarya, 1979; and Wood, 1971.

attention should be paid to the following points. Firstly, not all of these stages will necessarily occur and backtracking does take place before the final stage is reached. Secondly, this model places the problem recognition stage before the stage of innovation awareness, but some other models of the diffusion process begin with the stage of innovation awareness, followed by that of problem searching (Rogers and Adhikarya, 1979). An example of the former sequence is the recognition of the greenhouse effect and the continuing search for innovations to tackle the problem. The latter sequence is illustrated by the fact that when a government official is aware of an innovation, he or she may look for a possible problem which the innovation can solve, and try to promote the innovation. For instance, a federal or provincial government grant, offered to subsidize the cost of installing solar water heating equipment, may lead to a search for a location where installation of the equipment would be practical.

Attention should be placed on the differences between the two types of models, since which stage occurs first may affect the timing of adoption and the type of innovation applied to a particular problem. The adoption of a needed innovation will normally occur much more rapidly than an innovation which precedes awareness of an associated problem. Those adopting it may accept more risk (Kemp, 1982). Kemp presented Knight's

study of innovation with business organizations as an example. Knight (1967) concluded that organization in a state of constant crisis will have little time, or resources, left to consider innovations which do not provide the alleviation of critical problems. Any changes will tend to be internally directed organizational or cost-reducing. On the other hand, an organization with plenty of available slack resources will have the opportunity and initiative to conduct wider searches, external to the organization, which may identify innovations that could provide more attractive, long-term benefits. However, in this situation motivation to innovate may be decreased.

4.1.3. Re-invention

Innovation usually comes from outside an organization, and must be relevant to its problems. Component elements in an innovation are often modified, adapted, and changed so that they are suitable to the distinctive (specific) organizational situation. Organizations often adopt, not a specific blue print for an innovative activity, but a general concept whose operational meaning gradually unfolds in the specification process of adopting and implementing the new idea (Rogers and Adhikarya, 1979).

Re-invention is the degree to which an innovation is changed by the adopter in the process of adoption and

implementation, after its original development (Rogers and Adhikarya, 1979:75). A basic reason for re-invention is that each organization tends to match an innovation with a different problem. Therefore, the degree of re-invention is likely to be greater when there is wider heterogeneity in organizational problems with which the innovation is matched (Rogers and Adhikarya, 1979). This re-invention principle can be used to interpret the development of the Hornby Island recycling program, particularly the establishment of the "free-store" and the way in which it is dealing with plastics.

4.2. RESEARCH DESIGN

Having specified the research objectives and the theoretical framework, the present section deals with all aspects of research design. It begins with the generation and refinement of a set of interviewing questions, the procedures for sampling, and the operation of interviews. This is followed by a description of the design, pretest and administration of a questionnaire. The chapter closes with the presentation of several techniques used for the data analysis.

4.2.1. Interview

The preceding discussion suggests that two questions are of utmost importance in the evaluation of the Hornby Island recycling program: 1) how successful is the program? and 2) how has the program been developed? In order to answer these questions, technical data must be collected relating to such factors as the materials being recycled, the operation procedure, the financial feasibility, the organization and the development of the program. Informal and unstructured interviews best serve this purpose.

Interviews were chosen as a data collection method for several reasons. Firstly, interviews provide the greatest opportunity for effective communication (Skopec, 1986). They allow for a more complex and lengthy survey, as well as the development of a better rapport with the respondents. Since the evaluation of the Hornby Island recycling program required collection of some technical data, this advantage became very important. Secondly, interviews allow for probing of information which was not anticipated. Finally, where the study area is geographically small such as in this case, interviews are also an economic means of data collection.

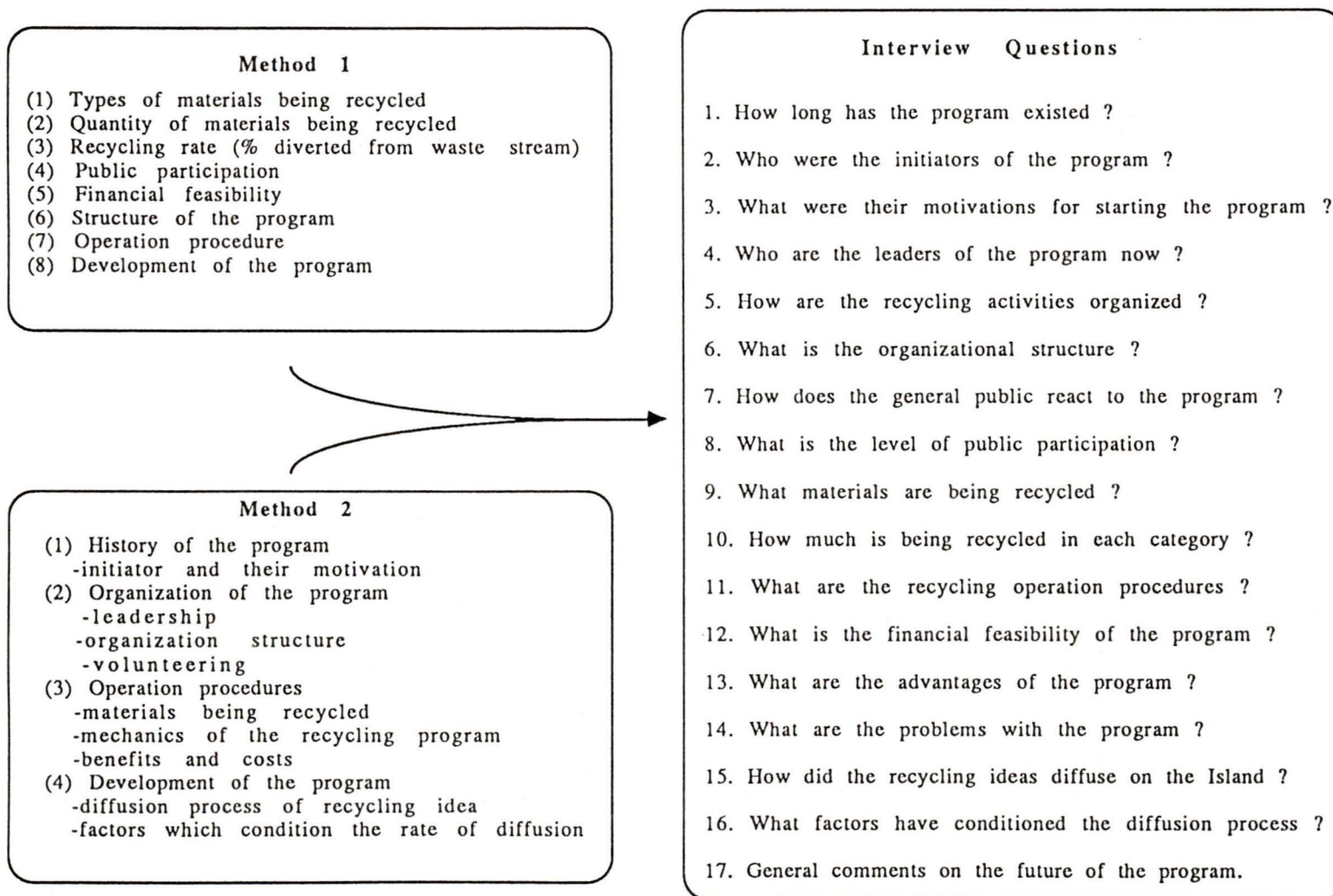
Before interviews could proceed, a set of questions had to be developed. The procedure for this process were as follows: a search of published literature on evaluation of

recycling programs was conducted to establish the variables to be measured. A review of several studies in North America and Europe (Glenn, 1988b; Peters and Grogan, 1988; Stone, 1988; O'Leary and Walsh, 1988; Lilley, 1985; OECD, 1983; and Stanley Associates Engineering Ltd, 1981) revealed that there was a high degree of consistency in the criteria used so that this procedure elicited, after eliminating redundant items, a total of eight variables (see 'method 1' in Table 4.2).

This list of variables was supplemented by the results of the discussion with the supervisory committee, three Hornby Island residents and six geography graduate students. These individuals were asked to comment on the variables selected and indicate where changes could be made. The results were summarized into four categories of variables (see 'method 2' in Table 4.2). By combining the results of both procedures, a final set of questions was developed as a general guideline for the interviews (see 'interview questions' in Table 4.2).

When conducting interviews, one must define the population and sample. In this study, the population was community leaders, members of the recycling committee and operators of the recycling depot. Community leaders were defined as 'those few individuals who make decisions that affect the lives of a relatively large proportion of the

Table 4.2: The Development of the Interview Questions



community' (Lasseby and Fernandez, 1976). Since there is no formal municipal government on the island, and the Hornby Island Residents and Ratepayers' Association is the informal governing body for municipal affairs, the executive members of the Association were chosen as community leaders. The Recycling Committee is one of the committees of the Hornby Island Residents and Ratepayers' Association, and administers recycling activities on the island. Since the membership of the committee varies over time, only the members still on the island were included in the population. The operators of the recycling depot deal with the every day operation. Representatives of the above groups were selected for interviews because it was felt that they were most knowledgeable about the local situation and the recycling program. As a result, it could be expected that their perceptions and opinions would yield significant insight about the program.

Stanley Associate Engineering Ltd. (1981) reviewed 15 recycling operations in British Columbia, which were engaged in recycling materials from municipal solid waste following source separation in the home. It was found that typically these operations had been initiated by a group of concerned citizens who formed a non-profit association for the purpose of diverting useful materials from the waste stream. Since most members of the subgroups mentioned above were also

initiators, or promoters, of the program and were actively involved in its organization and operation, interviewing them also helped understand their motivation and attitudes towards recycling.

The interview sample size was arrived at by consulting with community leaders, and then developing a list of people who represented a good cross-section of those involved (Table 4.3). The actual numbers of each subgroup in this quota sampling approach were dictated by two considerations. Firstly, the same number should be selected from each subgroup, so that some direct comparison could be made among them. Secondly, an attempt was made to cover as many members as possible in each subgroup.

Table 4-3. Interview sample

Subgroup	Sample size
Community leaders	3
Recycling committee	3
Depot operator	3
Total	9

The interviews were conducted during a 10-day visit to Hornby Island by the author from August 23 to September 3, 1988. In most of the cases, the interviewee was first contacted by telephone and an appointment was made. Then the author approached the interviewee for the interview. The interviews were relatively informal and unstructured, using the interview questions as a general guideline, since each interviewee possessed different information, because of the different role he or she played in the recycling program. For example, the focus of interviews with recycling operators was on materials being recycled, recycling procedures and direct economic benefits and costs, whereas emphasis was given to information on the history, organization and development of the program during the interviews with community leaders. During the interviews, notes were taken with the permission of the interviewees. The purpose of the qualitative and informal interviews was initially to gather some technical data, but the results also helped to generate the major data collection instrument, the questionnaire.

Nine people were interviewed during May 26 to June 2, 1990, to update the information gathered in 1988, because many changes had occurred since that date. The latter interviews followed the previously used guidelines. However, emphasis was placed on changes that had occurred to the recycling program since the initial interviews.

4.2.2. Questionnaire Survey

A questionnaire was designed to gather information on public opinion towards the Hornby Island recycling program. This survey was built around questions about the following: 1) general awareness of the program, 2) information on public participation in the program, 3) information on attitudes towards recycling and 4) personal socio-economic information. It was anticipated that the information derived from the survey would help evaluate how successful the program is and explain why recycling had been adopted by Hornby Islanders as a municipal solid waste disposal method, while it was still being resisted by the majority of Canadian communities. It was hoped to explore the interrelationship between recycling behaviours and the socio-economic characteristics and attitudes towards recycling.

There were several reasons for choosing this technique. Firstly, the low cost of communicating by mail, especially when compared to travelling to the respondents' locations, gave the questionnaire a significant cost advantage over other techniques. Secondly, questionnaires could derive more relaxed and carefully considered answers because of the fact that the researcher did not administer the questions in person. This relieved the respondents from having to reply at the time of contact. Thirdly, the absence of the researcher almost eliminated any apprehensions that respondents may have

about a stranger approaching them, either in person or by phone. Finally, a greater objectivity and accuracy in response could be attained, because the informant answered written questions without the researcher being present, and there was no likelihood of the researcher clarifying terms differently and affecting the sample population unequally (Stoddard, 1982).

However, the mail-questionnaire was not without its drawbacks. As Stoddard (1982) suggested, the first problem associated with gathering data through a questionnaire is that dependence solely on the written word may actually produce distortions due to variation in respondents' reading abilities and their subjective interpretation. The second major difficulty is their low-return rate. In light of this, some techniques were employed in the process of designing and administering the questionnaire to reduce these problems to a minimum.

The design of the questionnaire followed general principles provided by Backstorm and Hursh-Cesar (1981) and supplemented by guidelines from Stoddard (1982), Jolliffe (1986) and Dillman (1978). To minimize the problem of possible distortions, the author used simple, day-to-day language to clearly word the questions and answer choices, and arranged them in a logical order. Some other strategies, such

as asking questions on key factors in several different ways, were also used. In an attempt to improve the return rate, the author included a covering letter with the questionnaire. This explained who the researcher was and what he was doing, and politely asked the respondents to fill in and return the questionnaire. In the letter, a promise was also given that all the information would be treated anonymously and in strictest confidence. Several other safeguards were also employed in the administration of the survey in an attempt to reduce the impact of a potential low-return.

After the questionnaire was developed, it was pretested from October 1 to October 15, 1988. In the pretest, 14 copies of the questionnaires were distributed, 7 to geography faculty and graduate students and 7 to other friends in different sectors of society. The respondents were asked to indicate any weaknesses of the questionnaire, and to suggest where changes could be made. The author also discussed their reactions with them. Comments and suggestions were collected and corrections were made before mailing the questionnaire, thus eliminating any misleading materials.

The final format of the questionnaire was a booklet of five pages (8.5 x 11 inches) in length. The questions were typeset and printed in black letters on both sides of yellow paper (See Appendix A). The questionnaire began with an

introductory letter, on Geography Department letterhead, entitled "The Recycling Program On Hornby Island: A questionnaire Survey".

The survey had five sections. Section A was designed to gather data about the general awareness of the Hornby Island recycling program and consisted of 9 questions. Question 1 aimed to divide the respondents into two groups according to their awareness. Question 2 probed the source of information. Questions 3-7 were multiple choices and were used to test the familiarity of respondents with the operation of the recycling program. Since the 'free-store' is an important innovation of the recycling program, the awareness of it was probed by questions 8 and 9.

Section B of the questionnaire dealt with participation of respondents in the Hornby Island recycling program. Questions 1 and 2 sought information on general participation. Questions 3-6 were directed more specifically to everyday recycling activities. Question 7 asked the respondents to answer whether they used the 'free-store', and in a similar vein, Question 8 asked them whether they considered recycling when purchasing new products.

Section C of the questionnaire collected information on the respondents' opinion of the Hornby Island recycling

program. The first two questions used a five point uni-polar scale (ranging from 'very successful' to 'very unsuccessful') to record respondent's 'rating' of the recycling program and six aspects of the program. The aspects were: to produce revenue, to conserve and reuse natural resources, to reduce pollution, to reduce taxes and to create jobs. The third question asked respondents to rate, on a scale of 1 to 5, the administration and promotion of the recycling program (1 for very good, 5 for very bad). The last two questions were designed for respondents to comment on the inadequacy of the program. Question 4 asked the respondents to check the answer choices provided, whereas question 5 was in an open-ended format and collected comments on how improvement could be made to the program.

As mentioned in chapter 2, differences of opinion exist on the effectiveness of various disposal alternatives in solid waste management, and the benefits and costs of recycling. Section D of the questionnaire was developed to examine respondent's attitudes towards these aspects. Three types of questions constituted this section. 'Rating' was used in question 1, which asked respondents to rate landfill, incineration, composting and recycling on a scale of 1 to 5, ranging from "very good" to "very bad" respectively. The second technique in this section was 'ranking' and was used in questions 2-5. An assumption of this attitude measurement was

the interchangeability of rating and ranking methods for measuring relative importance. Thus a factor which is ranked high importance (say, number 1, 2, or 3) would be expected to receive an importance rating that is relatively high. Question 2 dealt with important factors in waste management and question 3 and 4 examined the benefits and costs of recycling (say, 1 for most important, n for least important). Question 5 asked the respondents to rank barriers to recycling. The last two questions in this section aimed at information about respondents' future involvement in recycling.

Section E collected standard socio-economic data, and was designed to permit an examination of possible correlations between recycling behaviours and socio-economic status. The last page was offered for any additional comments that respondents wished to make about the recycling program and the questionnaire survey. At the end of the questionnaire, a note of appreciation and instructions for returning it were also included.

There are about 280 permanent households on the Island and the questionnaire was sent to all of them. Since public participation in recycling is on a household basis, the relatively small number of households made surveying all of them both desirable and economically possible. Seasonal

residents and visitors were excluded from the survey, even though they represent substantial numbers in the summer. One reason for this exclusion was that they tend to live on the island for a short time and most of the visitors usually live either with the permanent residents, or at camp sites and bed-breakfast rentals, where the garbage is taken care of by the local operators or managers. The second reason for not considering them is that they are highly mobile, which makes surveying them very difficult.

Since no list of the permanent households could be discovered, the questionnaires were delivered to each of the 280 households by the island's postman on November 1, 1988. To combat the problem of potential low-return, the author made two visits to Hornby Island and wrote a letter to the editor of the local newsletter, prior to the survey, in order to publicize the research. The author also approached the Hornby Island Residents and Ratepayers' Association for assistance and was kindly invited to attend its general meeting. At the meeting, the author discussed the research with its members and appealed for their cooperation. Finally, two weeks after delivery, colourful fliers (Appendix A) were posted at the co-op store, the community hall, the ferry terminal, and other public places to remind the respondents to return completed questionnaires. Returned questionnaires were collected by placing a drop-off box at the co-op store. This was set up

immediately after the questionnaires were sent out. All these procedures were coordinated and administrated by a co-op store worker and the post office. Collection was terminated on January 30, 1989, some three months later when returns were obviously dwindling. A response rate of 37 percent was achieved. Since the questionnaires were delivered to all the households and were dropped off at the co-op store, no opportunity existed for a follow-up or a survey of non-respondents to establish the possible effects of non-response bias.

4.2.3. Data analysis

This section presents a brief discussion of data editing, coding, checking and analyzing procedures. Because of the highly structured nature of the questionnaire and the limited use of open-ended questions, relatively little data editing was required.

Since data were to be analyzed by using the SAS system, and entry to the computer system proceeded according to SAS' requirement. A coding sheet was developed, on which a variable was assigned for each questionnaire question and responses were coded by a number or a letter, with non-responses or double responses coded as blanks. The information were then keypunched into the university IBM mainframe computer system.

With the data coded and keypunched, a series of checks were carried out for data input errors. Firstly, all columns were checked and the misplaced or missing data identified by the computer. Once such problems were corrected, a double-check for coding was undertaken to make sure no errors had been made in converting data from the questionnaire into the coding numbers and letters.

Frequency tables for each question were then derived from SAS. The association between attributes were examined by cross-tabulation, and by application of the Chi-square test. Where there were too many cells with an expected frequency less than 5, Fisher's exact test was used to support, or reject, the hypothesized association. The correlation coefficients used to test the strength of associations were Phi for the 2X2 tables, and Cramer's V for the larger tables.

Some descriptive statistics such as mean, standard deviation and co-efficient of variance were also used to compare the relative importance of the attributes surveyed by rating.

The data obtained from ranking in Section D of the questionnaire was analyzed using Kendall Coefficient of Concordance (W). In the analysis, the first step was to test the hypothesis that the respondents had no agreement in

ranking the attributes surveyed in the questionnaire. If the W was found to be significant, the next step was to estimate the true ranking of the attributes by ranking them according to the sum of ranking, or the average ranking.

Chapter 5

THE EVALUATION OF THE HORNBY ISLAND RECYCLING PROGRAM: STUDY RESULTS 1

A major objective of this thesis is the evaluation of various aspects of the Hornby Island recycling program. The results of this assessment process are presented in this chapter in two discrete sections. After an initial discussion of the general background of the program, the technical aspects including what and how much material is recycled, and whether, as a result, the program is financially feasible are discussed. The second section examines human aspects of the program, including public awareness, participation and acceptance.

5.1. THE BACKGROUND OF THE HORNBY ISLAND RECYCLING PROGRAM

As discussed in Chapter 3, the Hornby Island recycling program was initiated in 1978, when the old dump was closed by Pollution Control Branch, Ministry of Environment of British Columbia. Since then, it has developed into what appears to be one of the most effective recycling programs in British Columbia. This section examines the leadership, organization, facilities and financing of the program, to provide a background for its evaluation.

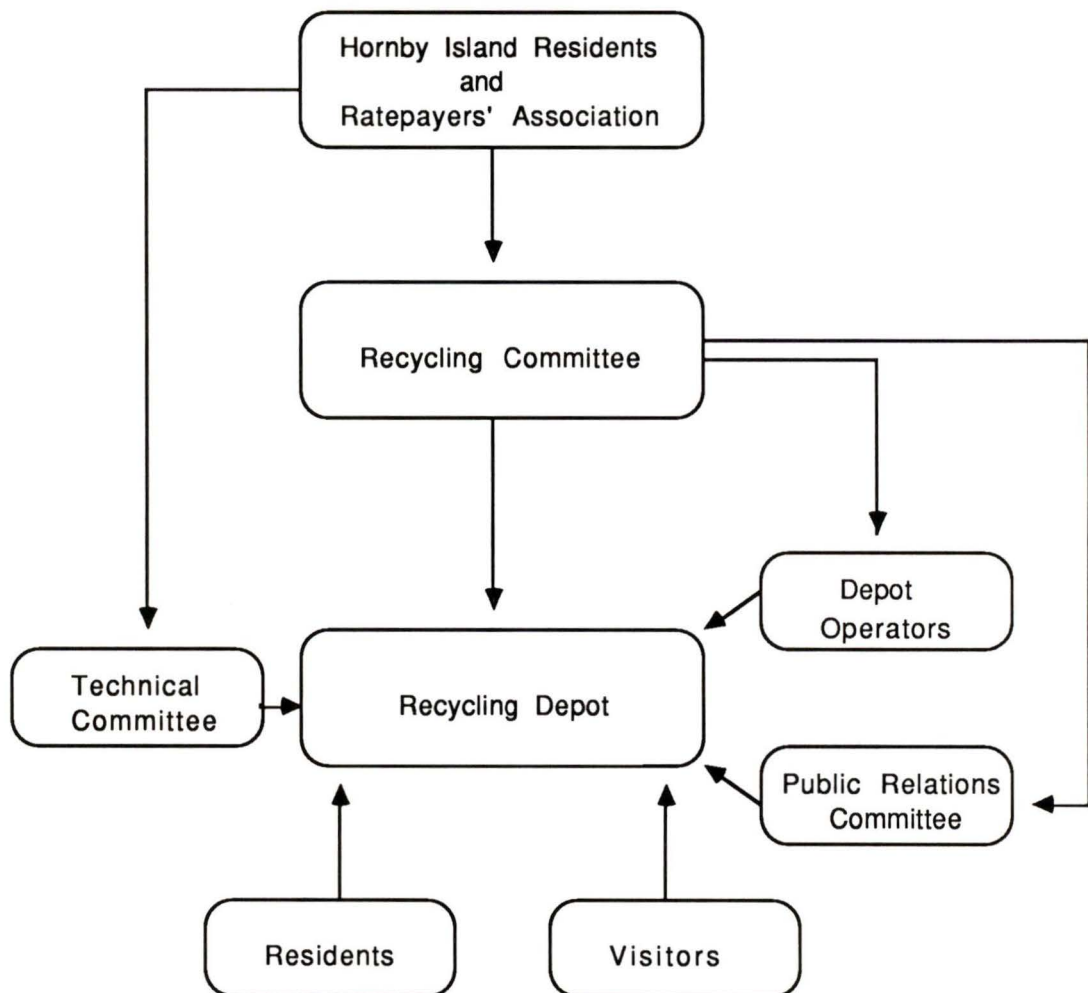
5.1.1. Organizational Structure

The Hornby Island recycling program is largely voluntary, characterized by a central depot. The program is organized by the Hornby Island Recycling Committee, managed by depot operators and supported by the majority of the residents on, and visitors to, the island. The following chart provides an overview of its organizational structure (Figure 5.1).

Hornby Island Residents and Ratepayers' Association

There is no formal municipal government on Hornby Island. However, Hornby Island Residents and Ratepayers' Association (HIRRA) is the informal governing body which deals with local affairs, and has authority over solid waste management. The association has a membership of 90 people in 1989, an executive board and several committees. Members must be 19 or older in age, either a property owner, or a permanent resident of the island for over 6 months. Decisions of the association are made through majority voting but an individual has to join the association for 42 days before being eligible to vote. The president, executive members of the board and committees are elected by its members. The association organizes meetings on recycling and oversees the work of its recycling committee.

Figure 5.1: The Organizational Structure of the Hornby Island Recycling Program



The Recycling Committee

The Recycling Committee is one of the five committees of the Hornby Island Residents and Ratepayers' Association. It is composed of a group of concerned citizens, who have been instrumental in formulating and working towards effective solid waste management on the island. The committee has been responsible for establishing, managing, and promoting the recycling program and is in charge of the program's research, decision-making, budgeting and book-keeping. The size of the Recycling Committee and the frequency with which it meets vary depending on the changing situation, the need for improvement, and public opinion.

The Technical Committee

The Technical Committee was a temporary committee set up by the Hornby Island Residents and Ratepayer's Association. It was formed in August 1988 to respond to the need for technical research to evaluate the recycling program. The main objectives of the committee were to (1) examine whether plastic burning caused pollution problems on the island; (2) investigate new technologies available for small community solid waste management with particular emphasis on composting and incineration, and (3) assess the implications of these technologies for improving solid waste management on Hornby Island. At the end of its research, the committee recommended an end to burning plastics on the island. The committee also

made presentations about municipal solid waste management to the Waste Management Branch, Ministry of Environment of British Columbia.

The Public Relations Committee

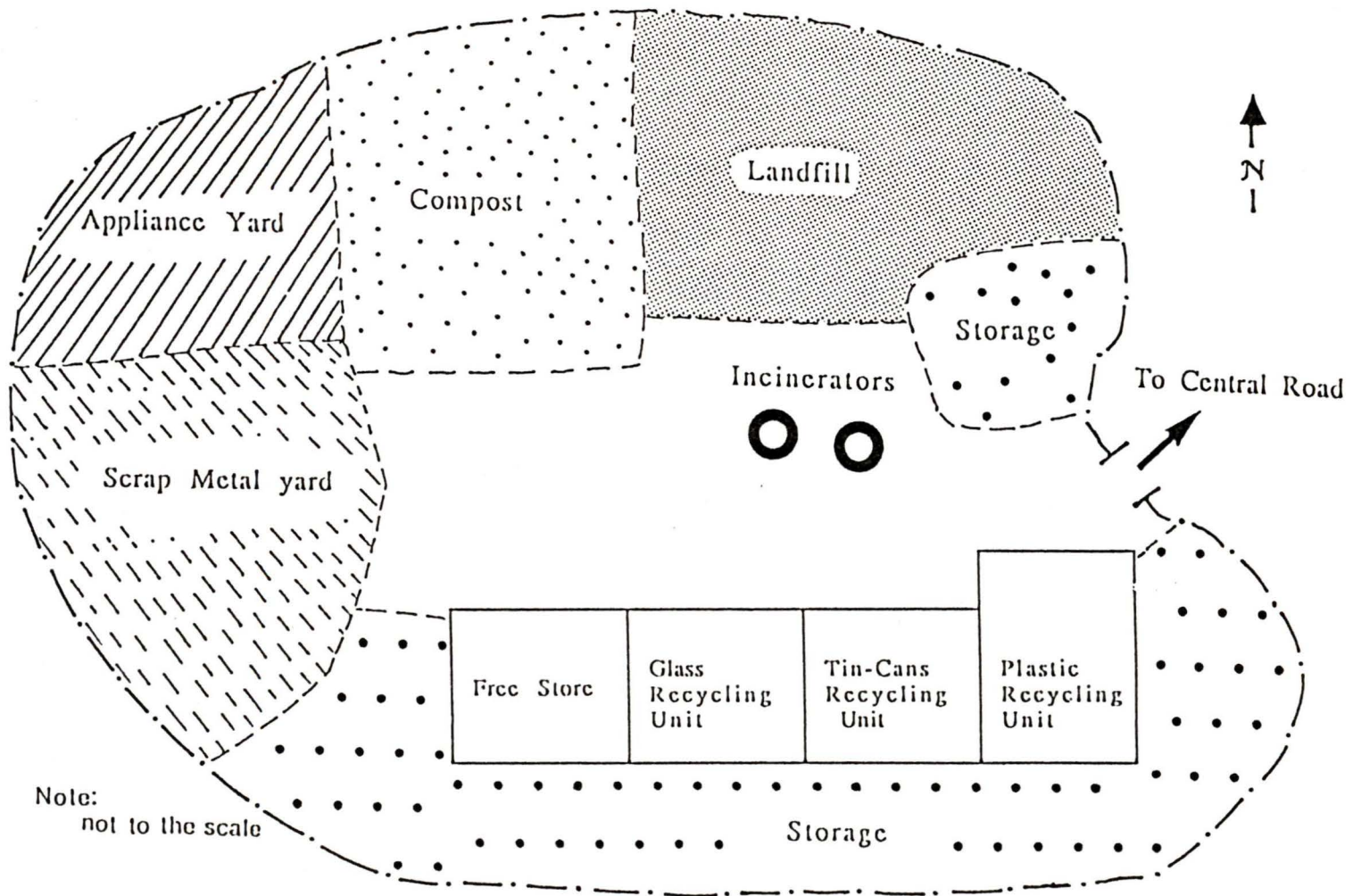
A public relations committee was established in 1989 to promote the recycling program. Under the leadership of the recycling committee, this committee is in charge of making brochures and posters, and writing letters to newspapers. The committee played a major role in successfully organizing the recycling fair which took place in August 1989.

The Recycling Depot

The supervised recycling depot provides a focus for the program. It is located in the centre of the island, off the main road (Figure 3.1). The depot is located on crown land, occupies an area of about 10,000 square meters, and is surrounded by coniferous trees. It consist of a free store, a glass recycling, a tin-can recycling, and plastic recycling units, a burner, a scrap metal pile area, compost, and a landfill (Figure 5.2 and Photo 1).

The free store, and the glass, tin-can and plastic recycling units are perhaps the most important facilities available to the recycling operation. The free store (Photo 2) is mainly a warehouse, where all sorts of reusable

Figure 5.2: The Sketch of the Hornby Island Recycling Depot



materials, such as clothes, footwear, books, appliances, are sorted and categorized on the shelves. The store is open to everyone, and is free of charge both to the suppliers and the users. The free store is an important innovation and serves as a very significant island resource centre.

The glass recycling unit (Photo 3) consists of a clearly-labelled counter, a grinder and several concrete containers. The incoming glass bottles and jars are sorted according to their colours, ground by the grinder, and stored in the concrete containers.

The equipment of the tin-can recycling unit (Photo 4) includes a clearly-labelled sorting quarter, a motor-driven hydraulic compressor and a storage area. At the sorting quarter, different kinds of small metals (mostly cans) are separated and put into the appropriate bins. The sorted cans are then compressed into drums and piled in the storage area.

The plastic recycling unit (Photo 5) is a new component built in 1989. It consists of sorting quarter, a \$3000 Westpress baler and storage areas. At the sorting quarter, the recyclable plastics are separated from the non-recyclable plastics. The recyclable plastics are put into big metal-wire cages and then placed in the store area, whereas the non-recyclable are baled, piled and stored elsewhere.

The burner (Photo 6), is a primitive metal furnace that is used to incinerate burnable materials as they arrive at the depot. The scrap metal area (Photo 7) is simply a piling site for scrap metals before marketing. Composting was set up when the recycling program was initiated in 1978, but has not been used effectively. Since November 1989, an attempt has been made to use composting to cut down the amount of material burnt. Currently metal barrels (Photo 8) are used to compost materials such as food scraps, yard wastes and unbleached papers. However, a new facility is being built with a \$22,300 grant from Environment Canada. The composting site will include compost bins, covered sorting, a small tractor and shredder, and an area to house the equipment. The landfill site is a dump for construction debris and anything else which cannot be handled by recycling and burning.

Each year from May 18 to September 7, the depot is open from 11:00 AM to 2:00 PM. At all the other time of the year, it opens Thursday through Sunday only. During opening hours, residents and visitors can take their recyclable materials to the depot, where further sorting and processing are undertaken.

The depot is currently in the process of being granted a permanent operation licence. When this occurs, it will be possible to have hydro power supplied to the depot. It is

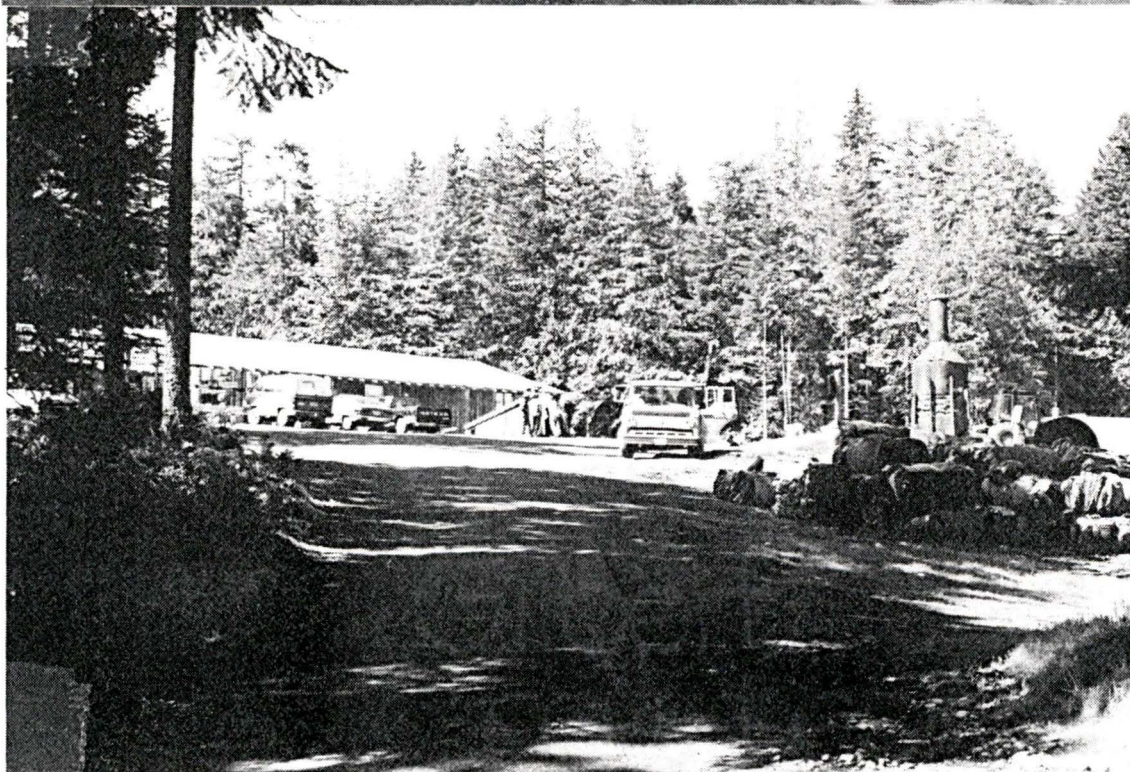
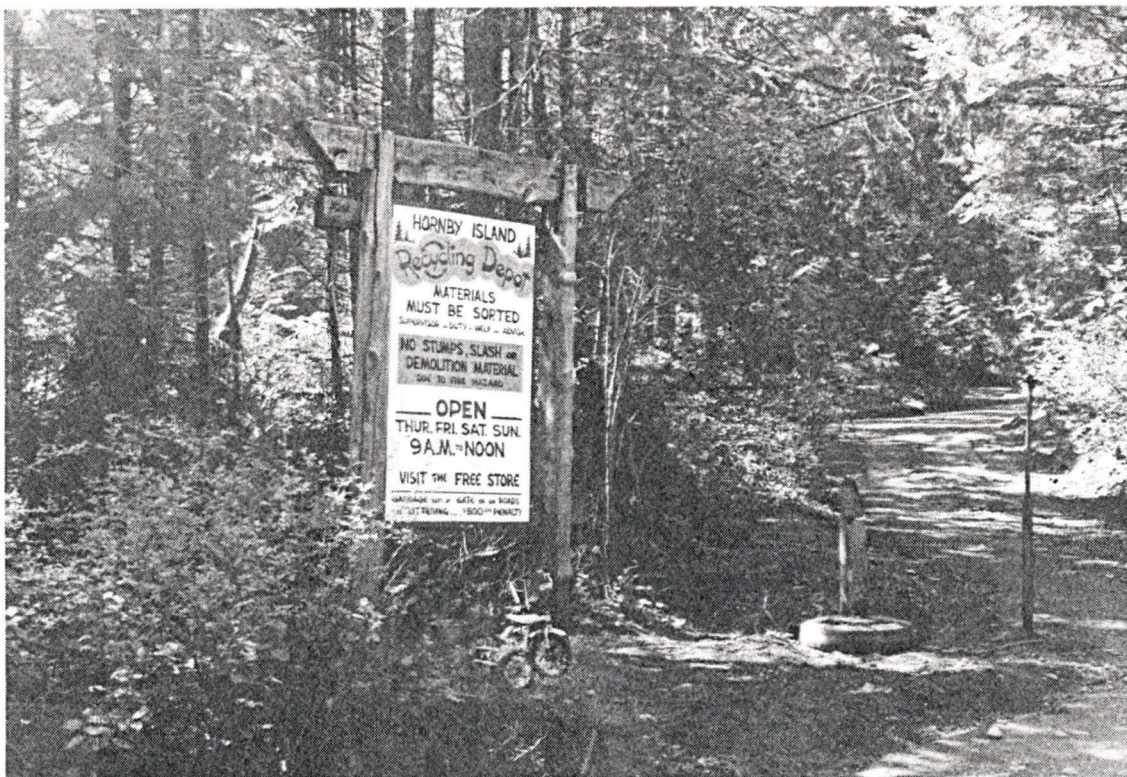


Photo 1: Hornby Island Recycling Depot

Top: The Entrance To The Depot

Bottom: The Depot



Photo 2: The Free Store

Top: The Clothes Department

Bottom: The Books and Toys Department



Photo 3: The Glass Recycling Unit



Photo 4: The Tin-can Recycling Unit

Top: The Sorting Section

Bottom: The Storage Area (In the center background is the can crusher)

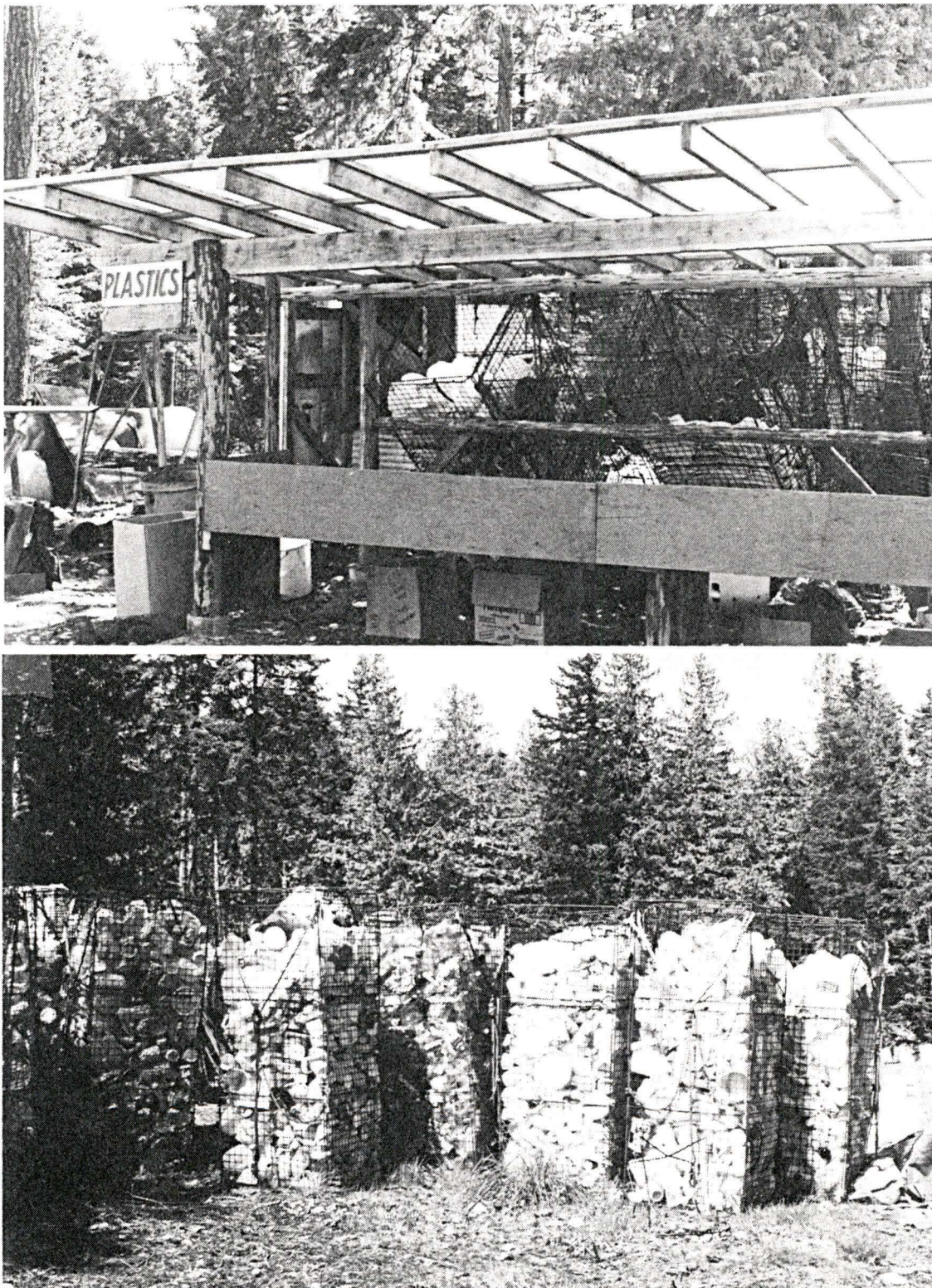


Photo 5: The Plastic Recycling Unit

Top: The Sorting Unit

Bottom: The Storage For Recycled Plastics



Photo 6: The Burner



Photo 7: The Storage Area For Scrap Metals



Photo 8: The Composting Facilities

also possible that a well will be drilled to avoid having to depend on water tanks for fire protection.

The Depot Operators

Routine operation is supervised by the depot manager, a contractor who is responsible to the Chairman of the Recycling Committee. The depot manager supervises its operation, monitors the incoming materials and sorting process, and offers any required assistance. He employs extra help on his own initiative by using the depot's allotted funds. He employs an assistant year round, and a third person in the summer when seasonal residents and visitors greatly increase the amount of municipal solid waste on the island.

The Volunteers and participants

The last, but perhaps the most important element in the recycling program is the substantial voluntary cooperation of the local residents who separate the recyclable and take them to the designated bins at the depot. Voluntary support is also provided by some concerned visitors who actively participate in recycling activities while on the island. Many volunteers devote their time to help operate the recycling program. For instance, every Wednesday morning, five to six volunteers take on the sorting of the reusable items and the organization of the free store, keeping it tidy and easy to use.

5.1.2. Financing

The main source of revenue for the program comes from Hornby Island's taxpayers via the Comox-Strathcona Regional District. Hornby Island's taxpayers used to pay a municipal solid waste disposal tax for the Pigeon Lake landfill, but the island never used the landfill. After the establishment of the Hornby Island recycling program in 1978, an agreement was reached with the Regional District to relieve the island of its contribution to operating Pigeon Lake landfill. The solid waste disposal tax, collected from the island, was returned to the recycling program as its operating fund. In 1989 this source of revenue provided \$26,100. Another source of funding comes from the sale of recycled materials. After transportation costs were deducted, this revenue varies greatly, ranging from \$0 in 1987 to \$1,994 in 1985. Other source of funds including pamphlet advertisement, donations and miscellaneous contributions.

5.2. THE TECHNICAL ASPECTS OF THE PROGRAM

Having discussed the leadership, organization, facilities and funding of the program, this section of the thesis investigates its technical aspects, including what and how much material is recycled, and whether, as a result, the

program is financially feasible. The discussion is based on the data derived from the interviews with the community leaders and the recycling operators, supplemented from the questionnaire survey.

5.2.1. Recycled Materials

If the principal objective of recycling is to divert useful materials from landfills, the types of materials and the volume of each material being recycled become two critical criteria by which success of the program is assessed (Glenn, 1988b). From interviews with the executive members of the Hornby Island Residents and Ratepayers' Association, members of the Recycling Committee and the operators of the recycling depot, it was found that a variety of materials are being recycled. These include glass, tin-cans, scrap metal, plastics, cardboard, cloth and rag materials and many kinds of household items.

This finding was further confirmed by the questionnaire survey. Of the 104 households which responded to the survey, 99 per cent said that they recycled glass and metal-cans, 36 per cent said they recycled newspapers, and 38 per cent reported they recycled books, magazines and other paper products. In the survey, 10 people also indicated they recycled plastics and 7 said they composted kitchen and garden waste. The questionnaire survey was conducted in December

1988, before the program started to recycle plastics, cardboard, cloth and rag materials. Since last year, these materials have also been recycled, with very active resident participation observed by the depot operators.

Hornby Islanders are also involved in recycling a wide range of household items including clothes, footwear, toys, furniture and major or minor appliances. The following table (Table 5.1), derived from the questionnaire survey, illustrates the nature of such materials and the number of people who reported recycling them.

Table 5.1: Household Items Recycling in the Hornby Island Recycling Program

Materials	Number of People	% of respondents
Clothes and footwear	38	37
Toys	7	7
Furniture	5	5
Appliance and other household items	17	16
Auto parts	5	5
Building materials	5	5
Metal	14	13
Magazine and books	6	6
Compost	7	7
Plastics	10	10
Anything useful	18	17

5.2.2. Operational Procedures

Separation

Gross separation is carried out usually before but sometimes after garbage reaches the recycling depot. The Recycling Committee and the depot set the regulations for separation, which are widely advertised through a well-illustrated brochure (Appendix B). There have been some changes in separation of recyclable materials since the beginning of the program. At present, residents and visitors are asked to clean and separate their solid waste into two major groups and 8 categories (Table 5.2). When these

Table 5.2: Source Separation of Recyclable Materials

-
1. Common household waste group
 - 1) Cans and glass
including tin cans and bottle caps, aluminum cans and foil, glass jars and bottles, and light bulbs and ceramics
 - 2) Burnable
including papers and disposable diapers
 - 3) Plastics

 2. Other sorting group
 - 1) Free store items (Anything still useable)
including clothes, footwear, books, toys, tools, small appliances, furniture and so on
 - 2) Scrap metals
including derelict vehicle, major appliances, bikes, parts and other scrap metals
 - 3) Cardboard and Rags
 - 4) Compostable
including kitchen waste and yard waste.
 - 5) Toxic Waste and batteries
-

materials reach the depot, further sorting is undertaken under the supervision of the depot operators. The questionnaire survey asked the participants where they separated their recyclable materials. Forty four percent of respondents answered that they sorted entirely at home, while 59 percent said that they separate partly at home and partly at the depot.

Collection

The collection method employed in this program is supervised depot drop-off. Residents and visitors take their separated materials to the depot for further separation and processing. This method has proved successful on the island.

Processing and Marketing

(1) Reusable

Anything still usable such as clothes, footwear, books, toys, tools, appliances and furniture are collected, categorized and put into the free store. A number of other reusable items and materials are also taken away and reused from the scrap metal and other piles. These range from parts from junked cars and appliances to wood board from furniture and metal wires from old mattresses.

(2) Glass

All returnable bottles are either taken back as a result of the deposit system, or claimed by the operators for refund, if they arrive at the depot. Other glass bottles and jars, brought in by the residents and visitors, require further separation into clear, green, and brown glass categories. They are then put on the clearly labelled designated counters. Until last year, glass bottles and jars were smashed by hand into drums, and put into concrete bins, the size of a dump truck. These concrete bins are kept covered with plywood to prevent cullet of wrong colour from getting mixed in. Last year, however, a glass grinder was purchased and was used to grind the glass into fine cullet. Broken glass is taken to either New West Glass Co. in New Westminster, B.C. or Northwestern Glass in Seattle for resale at a price of \$30-50/tonne.

The crucial factor in recycling glass is to keep the cullet clean. If wrong kind or colour of glass is mixed in, there will be no market for the end product. For instance, the last shipment of Hornby's glass cullet was refused by the purchaser, because some window glass got mixed into the bottle cullet. As a result, \$700 was lost. In general, sale of recycled glass can barely cover the cost of transportation to the market for the Hornby Island recycling program. Therefore, experiments have been undertaken to use ground fine

cullet for levelling and replacing gravel in local concrete construction. This application is planned as a supplementary measure to deal with recycled glass, if the market becomes too weak. No colour sorting is needed if the cullet will be used for such construction.

(3) Metals

The metals being recycled can be broadly classified into two groups, small items and big ferrous metal scrap. Small items include tin cans, copper, foil and small steel. Cans must be dropped into bins, as they are brought into the depot before clearing, removal of the label or flattening. Three quarters of a 45 gallon drum of such cans is tipped into a hopper and compressed into a block weighing approximately 15 kilograms. It is then stacked in the storage area, in any weather, on a pallet. Aerosol cans are first punctured by a simple device with a brass pin and then compressed. The bulk metals are kept until market price reaches about \$20/tonne and makes it worth transporting them to Richmond Steel Recycling in Richmond, B. C. Other metal items such as aluminum, copper and lead (car batteries) are also collected at the depot. These are worth more than other metals, but require intensive labour to prepare them for marketing. A private individual handles them through the depot in exchange for a share of the profits.

Big ferrous metal scraps consist mostly of derelict vehicles and major appliances. The reusable items, or parts, are claimed for reuse. For example, metal bars are used for reinforcing metal for concrete and sheet metals for roofing. According to depot operators, about 15 per cent of the metal scrap was reclaimed by the local residents and visitors for reuse. The rest was piled in the scrap metal area and then crammed into abandoned cars with their tops cut off. When about 80-100 such vehicles have accumulated, a crusher is normally called in from Richmond Steel. This company brings its own rig to the depot to flatten vehicles and take away scrap metal. The sale price has varied from \$30 to \$3 a tonne. The most recent shipment occurred in early 1990 when 147 tonnes were sold. If well organized, almost all scrap metals can be dealt with using this method. Any remaining scrap metal and appliances are stockpiled in the hope of getting someone to take away at no cost to the island. This procedure works well when the price of scrap metal is elevated. However, when the price is low, these materials may generate a problem, taking up valuable space needed for the depot operation. Refrigerators pose a special problem because of various pollutants they contain, and scrap dealers are reluctant to deal with them.

(4) Plastics

The prevalence of plastics in the world of "attractive and safe" packaging, and the high visibility in the litter stream have placed them in the centre of public attention and concern. While the majority of the municipalities are still troubled by the disposal of plastics, an intense effort has been made to deal with them on Hornby Island. For many years, plastics were burnt in the two home-made burners with other burnable material. The environmental effects of burning caused concern for some residents and led to a heated debate. As a result, the co-op store has implemented measures to reduce the plastics getting into the waste stream. In 1987, the depot started to pile plastics in a designated site in the hope of reclaiming them when methods of recycling plastics become available. The pile soon became too big and had to be covered by dirt, generating new problems such as taking up valuable space and posing a fire hazard.

In order to solve these problems, the islanders started to recycle plastics from May 1989. Currently, the plastics arriving at the depot are sorted into marketable and nonrecyclable two kinds. The marketable plastics are of four types: high-density polyethylene (H.D.P.E.), low-density polyethylene (L.D.P.E.), polypropylene (P.P.) and poly vinyl chloride (P.V.C.). They are mostly hard and rigid plastics in the forms of food and soap containers, milk jars, bleach

bottles, and mouthwash bottles. Other recyclable plastics include insulation bags, shopping bags and plastic sheets. Although those types of plastics represent 78 per cent of the plastics manufactured, for various reasons, Hornby Island can only expect to divert 10-30 per cent of its plastics. This is in part due to difficulties in identification. At present, marketable plastics are separated and put into three cages designated for polyethylene terephthalate (P.E.T.), dairy containers and soft plastics. The caged plastics which account for about 20 per cent of the incoming plastics are then placed in the storage site. Although no plastic has been sold yet, offers to buy have been made by Canada Fibre and Ecopack in Vancouver at a price of \$50-200 per tonne for purely separated, clean recyclable plastics.

The unidentifiable and nonrecyclable plastics are clumped together, balled into 140-kilogram bales and then stockpiled. When the pile site reaches its capacity, the baled mixed plastics are transported to Pigeon Lake landfill and staked for the storage marked "Mixed plastics from Hornby, Don't Landfill".

(5) Newspaper, Cardboard and Other Paper Products

In the past, paper products were incinerated in burners at the recycling depot. In an effort to cut down on the amount of garbage burnt, and at the same time to recover

recyclable materials, the depot started to recycle cardboard in August 1989. Since then, about 8 tonnes of baled cardboard has been sold to Paper Industries, in Vancouver at \$64/tonne.

There is no facility at the depot, or on the island, to recycle newspapers, because of the small quantity of old newspaper available. There is no home-subscription system on the island, the newspapers are sold only by the co-op store. According to the store, some 120 newspapers are sold a day, although this number may be doubled during the summer. There are also two local newspapers which are circulated free of charge on the island. One is delivered to each household twice a week, a total of 420 copies. The other is placed in pick-up boxes which are located on major sites, it has a weekly circulation of about 200. Therefore, it was estimated that approximately 8 tonnes of newspaper is getting into the island every year.

Despite a lack of facilities, many people are recycling newspapers on their own initiative. Some residents, for example, take old newspapers to Courtenay and other places where newspapers and additional paper products are being recycled. They are also used to start fires in wood stoves. Some books and magazines are also given to the free store for reuse. Newspapers which reach the recycling depot are burnt as fuel, together with disposal diapers.

(5) Cloth and Rag Materials

Some clothes are too old to be put into the free store and others have been in the store for sometime without any takers. Last year, in order to save valuable store space and to cut down on the materials burnt and landfilled, the depot started to recycle old clothes and rags. It was found that there are very good markets for textiles, if they are kept dry and not contaminated by oil, leather or vinyl materials. Textiles can be shredded to make industrial wiping cloths, and sold to Rotex Wiping Products in Vancouver for \$80/tonne.

5.2.3. Volume of Material Being Recycled

A survey was also conducted into the volume of municipal solid waste from final disposal diverted by recycling. There are several ways to establish the quantity of material being recycled. One approach uses the following analytic procedures: (a) the total amount of municipal solid waste is established; (b) its composition is calculated; and (c) the types and amount of materials recycled are then determined by the data derived from the procedures noted above through input and output analysis. This approach is scientific and has the advantage of achieving a recycling rate, that is, the percentage of recycled materials divided by the total municipal solid waste load. While this method is ideal, it is not practical for this research project, because of limited

research time and money. Another approach, often applied in the assessment of recycled materials, is to use the records of the recycling depot, or its operators, as the basis for calculation. It was thought that if reliable and systematic records were available, this approach would provide an efficient way of determining the amount of materials recycled. Therefore, it was chosen for use in this thesis.

When applying this approach, two problems became obvious. Firstly, a recycling rate cannot be obtained for the Hornby Island recycling program, because there are no data on the total municipal solid waste produced, or collected, on the island. Secondly, no systematic depot records are available. In order to overcome, or reduce, the impacts of these problems, the author tried to find every possible source of information to supplement the records by deriving data from shipping records of recycled materials leaving the island, and by analyzing the revenues from sales. Estimates of the Recycling Committee and the depot operators and some active recyclers were also used to verify results. Data on the current quantity of materials recycled, derived from the above methods, are summarized in Table 5.3. About 168 tonnes of materials are recycled annually, of which about 74 tonnes, or 44 per cent, consists of scrap metal. Glass is the next largest recycled commodity at 36 tonnes, or 20 per cent, of total materials recycled, followed by tin-cans, plastics and

cardboard which account for 15 tonnes or 9 per cent each. It should be recognized that most of the numbers in the Table 5.4 are best estimates. Table 5.3 does not include the less common metals such as aluminum, copper and lead, nor materials reclaimed by the residents and visitors through the free store or directly from piles at the depot.

In order to obtain an estimated market value for the materials recycled, the average market prices provided by the Recycling Committee were multiplied by the quantity of materials recycled. Total market value of recycled material in 1989 is estimated to have been worth between \$4,000 and \$10,000 (Table 5.3).

Table 5.3: Estimated Quantities and Market Value of the Material Recycled on Hornby Island
(1989 Data)

Materials	Amount (tonne/year)	Estimated Value
Glass	36	\$1,260-2000
Tin-cans	15	450
Scrap metal	74	220-2000
Cardboard	15	960
Cloth materials	8	640
Plastics	15	750-3000
Compost	5	
Battery	60 (pieces)	
Aluminium and copper	varies	
Total	168	4,280-10,000

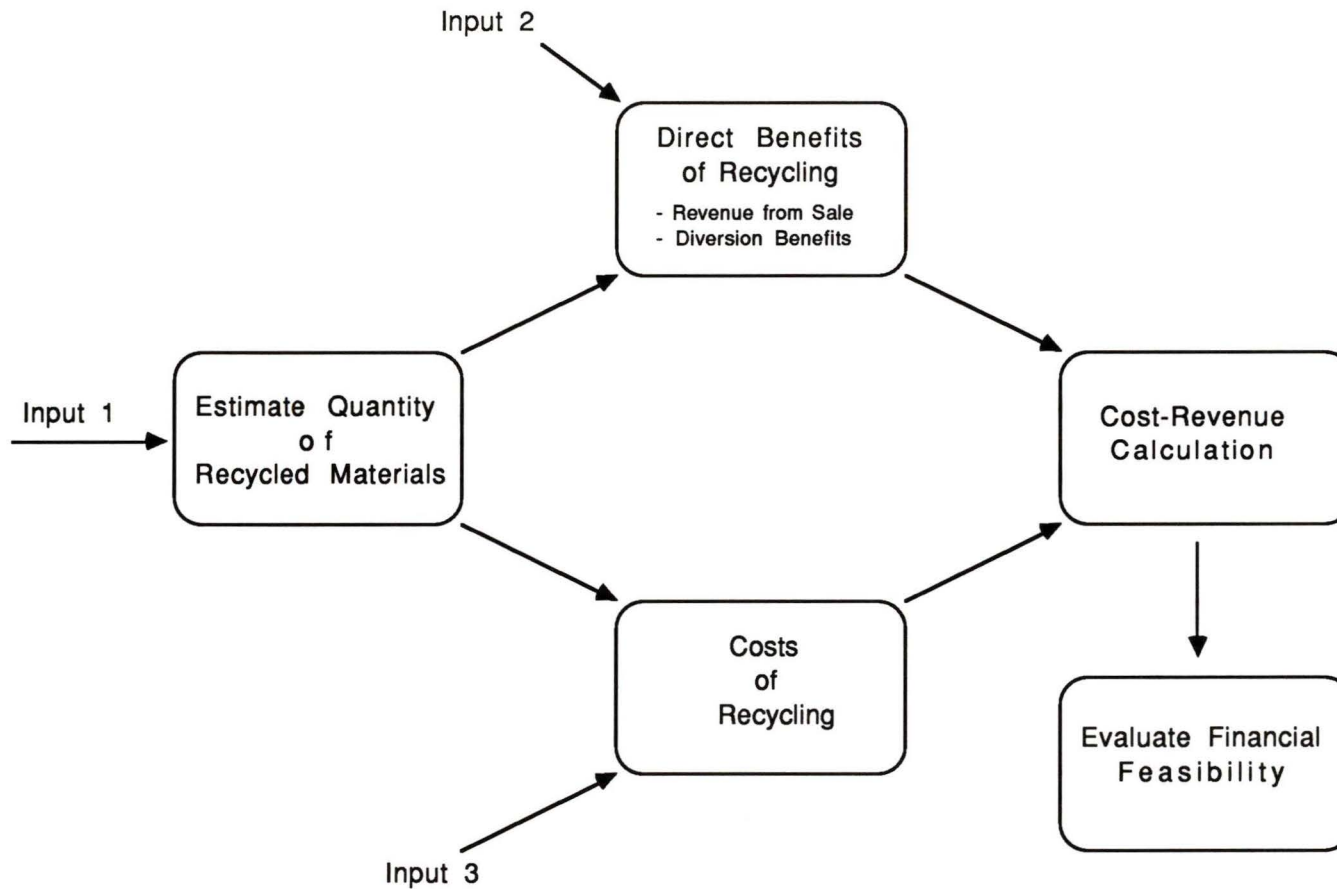
The percentage of waste recovered, that is, the recycling rate, is obviously a key variable in determining the effectiveness of a recycling program (Stanley Associates Engineering Ltd. 1981). However, as mentioned above, an accurate recycling rate cannot be calculated for the Hornby Island recycling program. However, an attempt was made during interviews of members of the recycling committee to obtain estimates of recycling rate of the program. In this manner, the current recycling rate was established at about 85 per cent.

5.2.4. Financial Feasibility

As the literature review revealed, financial feasibility is also a very important criterion in evaluating a recycling program. This section of the thesis seeks to examine whether the Hornby Island recycling program is economically feasible. In order to meet this objective, a financial feasibility assessment model (Figure 5.3) was employed. This model was modified from the one designed by Stanley Associates Engineering Ltd. (1981) to evaluate a specific recycling program. The overall model consists of three components which estimate:

1. the volume and types of wastes recovered by the program
2. the costs of recycling the recovered materials
3. the direct benefits resulting from recycling

Figure 5.3: Financial Feasibility Assessment Model for a Recycling Program



Modified after Stanley Associates Engineering Ltd. (1981)

Taken together, the components provide an estimate of its economic feasibility. As shown in the model, the assessment concentrates only on examination of the direct (tangible) costs and benefits of the Hornby Island recycling program, because of the complexity of assessing the intangible. The financial records of the recycling committee were used to quantify the revenues and costs of the program.

Because of the importance of relevant indirect (intangible) benefits and costs of recycling, this section also attempted to review the indirect (intangible) benefits of the Hornby Island recycling program through interpreting the results from the questionnaire survey.

The direct costs and benefits of recycling programs have been studied by a number of authors (Glenn, 1988a, Peters and Grogan, 1988, Stanley Associates Engineering Ltd, 1981, OECD, 1983, City of Portland, 1986, and Environmental Resource Ltd, London, 1985). Their findings are summarized below:

Benefits

- 1) revenue from sale of recycled materials
- 2) diversion credits
 - a) saving in collection costs
 - b) saving in disposal costs
 - c) saving in landfill space
- 3) other

Costs

- 1) separation costs
- 2) collection costs
- 3) transportation costs
- 4) processing costs
- 5) overhead costs
 - a) rent
 - b) utilities
 - c) advertisements and promotion costs
 - d) administration costs
- 6) other

This list was modified to fit the particular situation of the Hornby Island recycling program. The records of the program, from 1982 to 1989, were used to conduct the analysis and results were presented in table 5.4. The revenues of the program include the sale of recycled materials, diversion credits and other. The numbers in Table 5.4 for the sale of recycled materials are a net profit, that is, the money gained from sale minus the transportation costs. The diversion credits are the money saved by the recycling program compared to landfilling the same amount of municipal solid waste at Pigeon Lake landfill (for the estimation of diversion credits, see Appendix C). The costs of recycling is the money spent on the recycling program including labour, transportation, equipments, administration and promotion.

It was found that the greatest source of revenue has been the diversion credits. The major costs of the recycling program are labour, equipment and administration. The revenue generated from sale of recycled materials alone does not cover

Table 5.4: The Financial Feasibility Analysis of the Hornby Island Recycling Program

	1985	1986	1987	1988	1989
Revenue					
1) Sale of recycled materials ¹	1,994	1,338	0	0	5
2) Diversion credit ²	117,500	122,500	127,500	132,500	136,261
3) Other	503	393	250	1,419	2,199
<u>Subtotal</u>	119,997	124,231	127,750	133,919	138,465
Costs					
1) Labour	10,367	12,136	11,786	13,802	21,399
2) Transportation	-	166	283	817	828
3) Equipments	353	886	1,400	3,320	7,008
4) Administration	5,829	1,403	1,227	3,686	2,922
5) promotion	269	217	139	762	2,903
<u>Subtotal</u>	16,818	14,808	14,838	22,387	35,060
BALANCE	102,681	109,423	112,915	111,532	103,405

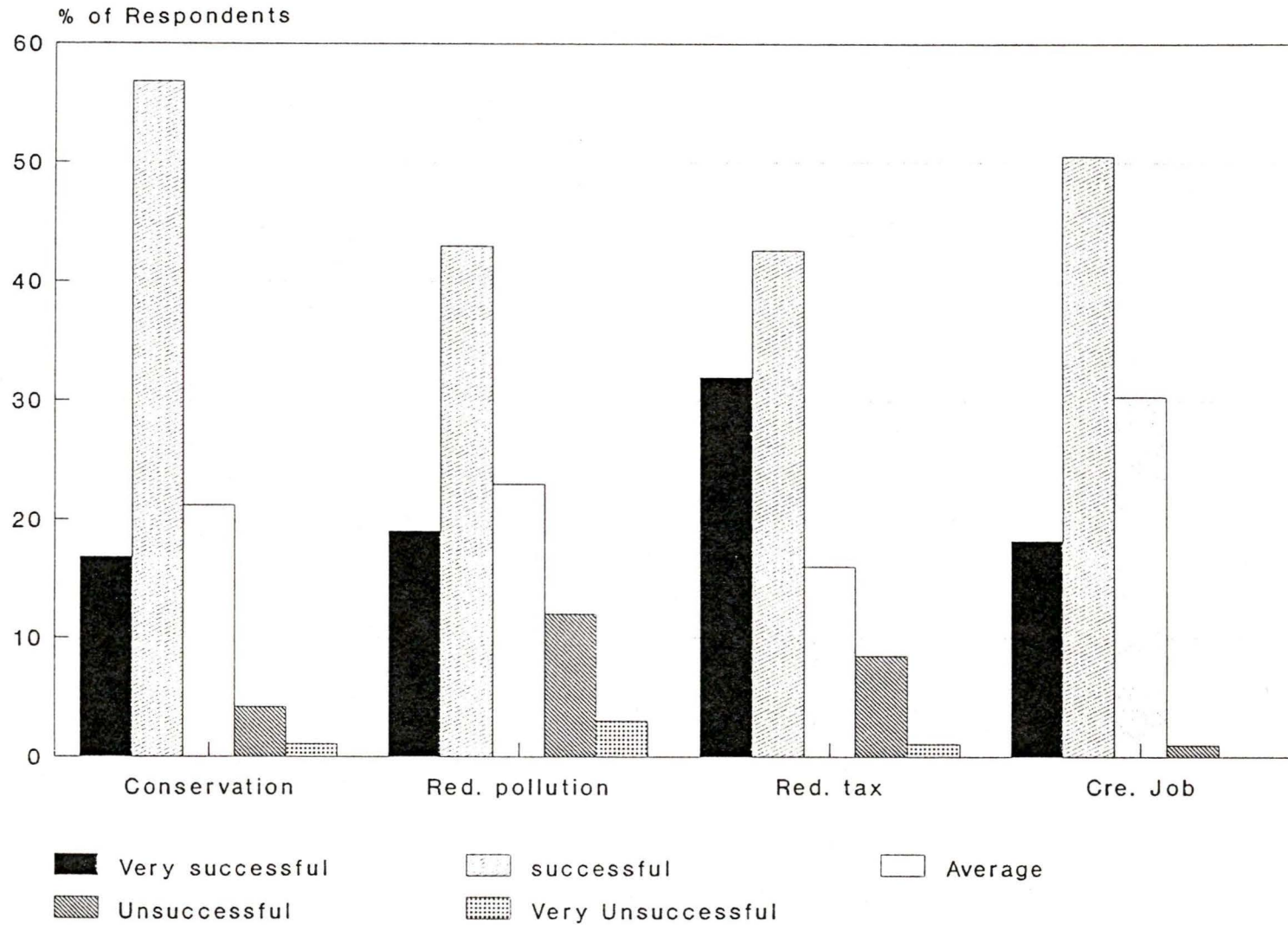
¹ Net profit after the deduction of transportation costs.

² For its estimation, please see appendix C.

the costs of recycling. However, if the diversion credits are included in its revenue, the recycling program is economically feasible and saves islanders over \$100,000 a year. This confirms the finding by Environmental Resources Ltd., London (1985) that long-term recycling succeeds economically only when financial benefits gained by the manufacturers and other users, or exporters, of the recovered materials exceed their cost. This perhaps goes some way to explaining why the Hornby Island recycling program has succeeded whilst most of other recycling programs stimulated by the conservation movement, in the 1970s, failed to survive. This will be addressed in more detail later.

It is difficult to attach monetary values to indirect (intangible) costs and benefits, but they may have an important bearing on the selection of an appropriate waste disposal method. Therefore, an effort was made to establish what Hornby Islanders think are the important indirect benefits generated by the recycling program. Question 2 of Section C of the questionnaire asked the respondents to rate, on a scale of 1 to 5, indirect benefits identified by previous studies. This included: conservation and reuse of natural resources (CONRES), reduction of pollution (REDPOL), reduction of tax (REDTAX) and creating jobs (CREJOB). Figure 5.4 shows the frequency rating discovered for each benefit, while Table 5.5 presents the data in the form of mean scores, standard

Figure 5.4: The Proportion of Respondents on the Indirect Benefits of the Hornby Island Recycling Program



deviations, and the co-efficient of variation, statistical measures which presume that the data, although reported in an ordinal form, represents an underlying continuum of importance. While this is an arguable point, it is used here instead of the median, because, in the case of such a short scale, this would reveal very little about the variation in response (Duffus, 1988).

The results of this analysis indicate that the respondents thought the program was moderately successful in generating the indirect benefits mentioned above, namely conservation, tax reduction, less pollution and job creation.

Table 5.5. The Mean Rating of Indirect Benefits of the Recycling Program

Benefit	N	Mean	Standard Deviation	Coefficient of Variation
CONRES	95	2.16	0.7898	36.60
REDPOL	100	2.37	1.0215	43.10
REDTAX	94	2.04	0.9606	47.03
CREJOB	99	2.14	0.7144	33.36

5.3. HUMAN ASPECTS OF THE RECYCLING PROGRAM

The following section explores three human aspects of the Hornby Island recycling program probed by the questionnaire survey. These were awareness, participation and acceptance. To achieve this goal, two methods of analysis, frequency tables and contingency tests, were utilized. The following section will discuss the data collected by the first three sections of the questionnaire survey and their analysis. Results are organized in three parts: Part 1 pertaining to the awareness of respondents about the Hornby Island program; Part 2 to public participation; and Part 3 to public acceptance of the recycling program.

5.3.1. Public Awareness

Awareness and knowledge of the Hornby Island recycling program on the part of the islanders provides insights into the nature of the program. Section A of the questionnaire was designed to gather information about public awareness. In order to increase the reliability of the survey, the section not only asked the respondents to indicate whether they were aware of the program, but also tested their levels of knowledge about some of its specifics. Table 5.6 summarizes the questions asked, their functions and the form of analysis. The information gathered was used for two purposes, firstly, to obtain a general picture of how aware the islanders were of the program. Secondly, it was used to test for association

Table 5.6: Summary Table of the Variables in Section A of the Questionnaire

Question Number	Variable Abbreviation	Type of Question	Function of Question	Form of Analysis
1	AWARREC	Awareness of the recycling program	Establish the level of awareness of the respondents	-Frequency table -Test association with participation in recycling
2	INFRANK1 INFRANK2 INFRANK3	Source of information	Establish the source of information and their relative importance	-Frequency table
3 4 5 6 7	LONGPROC PROKNOW HOWSEP HOWCOLL HOWPROC	Knowledge of the recycling operation	Establish the level of specific knowledge of the recycling program	-Descriptive analysis
8 9	AWAREFRE STORKNOW	Awareness and knowledge of the free store	Establish the level of awareness and knowledge of the free store	-Frequency table -Descriptive Analysis

between awareness and participation.

Question 1 was designed to divide the respondents into two groups: either aware or unaware of the program. The 101 usable questionnaires returned, however, demonstrated an overall awareness rate of 100 per cent. This extraordinarily high awareness rate raised a question of reliability, because it is unclear whether this awareness rate was representative of the entire island's population. One possible explanation for this 100 per cent awareness rate is that the Hornby Island recycling program has been very successfully publicized. Another possible explanation is that the people who do not recycle did not return the survey. From talking widely to the islanders, it was found that everyone contacted was aware the program. Therefore, the extraordinary high awareness rate was probably an accurate reflection of reality.

This high awareness rate was also supported by data collected by further questions (Questions 3 to 7), which were directed towards measuring levels of respondents' knowledge about the specific operation of the program. The results of this analysis are summarized in Table 5.7.

Table 5.7: The Level of Awareness of the Aspects of the Hornby Island Recycling Program

ASPECT		PERCENTAGE OF RESPONDENTS
OVERALL	(n=101)	100
LONGPRO	(n=100)	83
PROKNOW	(n=102)	98
HOWSEP	(n=102)	98
HOWCOLL	(n=100)	95
HOWPROC	(n=102)	99
AWAREFRE	(n=102)	100
STOREKNOW	(n=102)	100

Key:

OVERALL - Overall awareness of the program
LONGPRO - Awareness of the length of the program
PROKNOW - Knowledge of recycled materials
HOWSEP - Knowledge of separation
HOWCOLL - Knowledge of collection
HOWPROC - Knowledge of processing
AWAREFRE - Knowledge of the free store
STOREKNOW - Knowledge of the free store
n - The number of respondents

The results obtained from analyzing data collected by Questions 3 to 7 showed that the islanders were not only aware of the program, but also extremely knowledgeable about specific operations without exception. The general awareness rates of such details were all over 95 per cent. The only exception was the knowledge of recycling history (LONGPRO), which had a slightly lower rate of awareness (83%). This may be because some respondents are relative newcomers to the island, and may not know exactly when the program was initiated, despite being familiar with its operations.

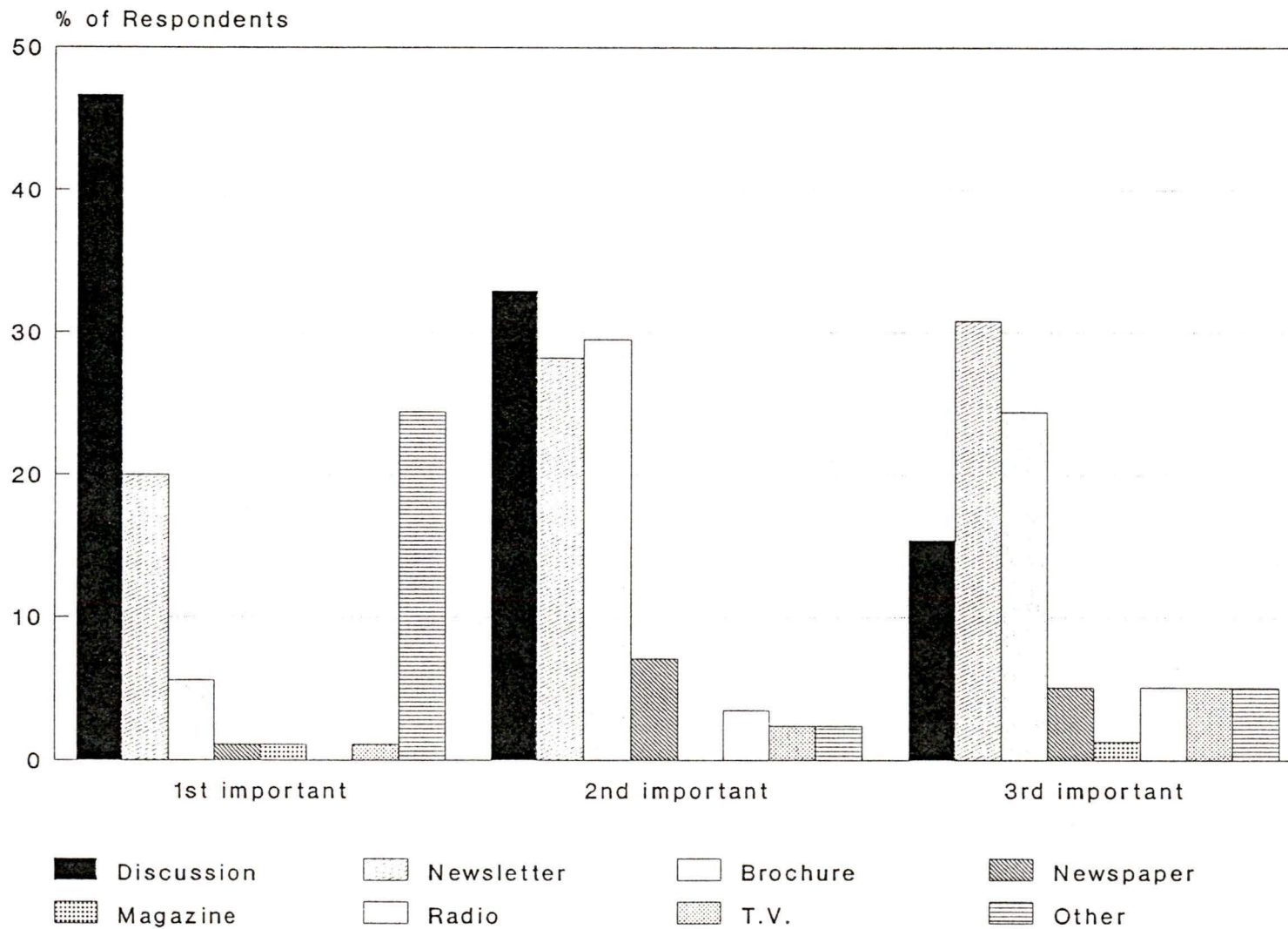
All questionnaire respondents were aware of, and had a good knowledge of, the "free store". This stresses the potential effectiveness of the "free store" in generating public awareness of a recycling program, and may have implications for attempts to promote recycling programs in other communities.

Question 2 was designed to probe sources of information about the recycling program. Respondents were asked to rank, in order of significance, their three most important sources of information. An examination of the responses to this question revealed that the most important information source was discussion with friends, followed in order of importance, by the newsletter and brochure (Figure 5.5).

The newsletter commonly referred to is called The First Edition. It is published on Hornby Island and has served as a very important communication tool for the recycling program. Through the newsletter, the recycling committee and the depot manager inform the public of the up-to-date situation at the depot and the operation of the program and seek public cooperation. Concerned residents also write to the newsletter to express their opinions about the programs.

It is also very interesting that 24.4 % of respondents rated "other" as the most important source of information.

Figure 5.5: The Importance of the Source of Information



The "other" sources cited and the number of people reporting them were: living on the island (16), public meeting and Ratepayer's Association (12), personal involvement (8), road signs (4), recycling depot (2) and having to recycle (2). Some of these sources, however, seem to be a restatement of the selection already offered the respondent.

5.3.2. Public Participation

The level of public participation is a major factor in the success, or failure, of recycling programs which are dependent on source separation by the residents (Stanley Associates Engineering Ltd. 1981). Participation rates can be considered both as an influencing factor and as a result (OECD, 1983). Earlier studies shed considerable light on the influence of participation rates on the results obtained from the recycling programs. In general, when the participation rate increases, the unit cost of recycling diminishes (OECD, 1983). The literature review shows that, although evidence from various studies suggests a positive desire on the part of households to participate in recycling, actual participation rates often fall below 50 per cent (OECD, 1983).

Section B of the survey questionnaire was directed towards better understanding of public participation in the Hornby Island recycling program. Table 5.8 summarizes the questions asked, the nature of the question, and the form of

Table 5.8: Summary Table of the Variables in Section B of the Questionnaire

Question Number	Variable Abbreviation	Type of Question	Function of Question	Form of Analysis
1	PARTREC	Participation in the recycling program	Establish the participation rate	-Frequency table -Test association with awareness of recycling
2	LONGREC	Length of participation	Establish the development of the recycling program	-Frequency table
3	WHATRECA WHATRECB WHATRECC WHATRECD	The materials being recycled	Determine what materials are recycled	-Descriptive analysis
4	WHERESEPA WHERESEPB	The separation of the recyclable materials	Examine where the separation takes place	-Descriptive analysis
5	HOWDISPA HOWDISPB	The disposal of sorted materials	Examine how the sorted materials are disposed	-Descriptive analysis
6	TIMERECE	Time spent on recycling	Establish the level of participation	-Descriptive analysis
7	USEFREST	Use of the free store	Establish the level of free store use	-Descriptive analysis
8	CONSREC	Consciousness of recycling	Examine the shopping behaviour	-Descriptive analysis

analysis. In the analysis, the public participation was explored in three ways. The first of these was to obtain the overall public participation rate. Of the 280 households surveyed, 104 returned the questionnaire, but one did not answer the participation question. Of the 103 valid responses, all the respondents said that they were recycling, achieving an overall participation rate of 100 per cent.

The 100 per cent participation rate suggested by the Hornby Island questionnaire raised some questions. Perhaps respondents were less than honest about their involvement; or maybe only those who recycled returned the survey, whilst non-recyclers failed to participate in the survey, because of lack of interest. Since no pattern of non-response could be investigated, it is difficult to verify the rate by scientific, or statistical methods. Facing this problem, the author tried to talk randomly to many Hornby Islanders and asked them to comment on the percentage of the people who recycled. The answers were unanimous that every household on the island recycles; therefore, even though there is a possibility that households which do not recycle exist among the non-respondents, they probably represent only a minimal percentage.

There may be several reasons for this extremely high participation rate. Firstly, Hornby Island is a very small

island community and there is no other way to dispose of garbage. Secondly, the recycling program has been operating for several years and has been very well publicized. Thirdly, the islanders have a unique cultural history that favours simple living, so that their value system promotes active participation in the recycling program.

This total participation rate also created the same technical problem for statistical analysis as did the elevated overall awareness rate. The researcher initially wanted to test the association between awareness and participation, and to examine the social and economic characteristics of both the recycling groups and non-recycling groups. Because of 100 per cent participation rate, derived from the questionnaire survey, no such statistical analysis could be undertaken.

It is useful, however, to compare this figure with participation rates cited for other programs in North America (Table 5.9). Glenn (1988b) reported a survey of 21 home collection programs, undertaken by the Journal of BioCycle during March 1988. In these examples the overall participation rates ranged from 20 to 90 per cent, with the majority having an overall participation rate of between 50 to 70 per cent. A study which looked at 20 different programs of all sizes and types was undertaken by Peters and Grogan (1988). As seen in Table 5.9 they also found very similar

Table 5.9: The Comparison of Public Participation between the Hornby Island Recycling Program and other Programs in North America

Location	Participation Rate (%)	Location	Participation Rate (%)	Location	Participation Rate (%)
(1)		(2)		(3)	
Austin, TX	20-25	Wilton, NH	65	Nanaimo, BC	30
Cheltenham Twp, PA	40	Madison, WI	75	Ridge Meadows, BC	12
Davis, CA	60	Prairie du Sac WI	95	North Vancouver	27
Evesham Twp, NJ	85-90	Montclair, NJ	75-85	Grand Forks, BC	12
Groton, CT	75-85	Islip, NY	50	Princeton, BC	77
Haddonfield, NJ	95	Mecklenburg Co. NJ	70	Victoria, BC	15
Hamburg, NY	98	Marin County, CA	60	Chilliwack, BC	23
Marin Co. CA	60	San Jose, CA	58		
Mississauga, Ont.	80	Kitchener, Ont	84		
Mecklenburg Co, NC	71	Santa Monica, CA	28		
Niagara Falls,	75-80	Austin, TX	20-25		
San Jose, CA	58	Minneapolis, MN	20-25		
Seattle, WA	48	Ann Arbor, MN	25-50		
Springfield Twp, PA	70	Naperville, IL	35-40		
Sunnyvale, CA	50-60	Portland, OR	20		
Upper Moreland, PA	62	Champaign IL	65		
Ann-Arbor, MI	50	Urbana, IL	65		
Minneapolis, MN	25-30				
Montclair, NJ	85				

Source: (1) Glenn, J (1988b).
 (2) Peters, A. and P. Grogan (1988).
 (3) Stanley Associates Engineering Ltd. (1981).

participation rates. Stanley Associates Engineering Ltd. (1981) also found out, in its study of several programs in British Columbia, that the participation rates ranged from 12 to 77 per cent, with a mean of 28 per cent. Public participation in specific operations of the recycling program was also examined. This will be discussed in more detail later.

Questions 3 to 5 were intended to investigate what was recycled and how this was achieved. It was found that 99 per cent of the respondents reported that they recycled glass and tin-cans, 36 percent and 38 per cent recycle other paper products. Based on 103 respondents, 57.3 per cent of the respondents partially separated their recyclable materials at home, while the other 42.7 per cent separated their recyclable materials entirely at home. Ninety nine per cent of the respondents then took recycled materials to the depot, while only one household sent recycled materials to their neighbour. The study also showed that 4.1 per cent of respondents were composting.

Data from question 7 indicated that 68.5 per cent of the households which responded use the "free store". The time spent each week on recycling was established by Question 6. It was found out that 77.2 per cent of the respondents spend less than one hour, while 16.8 per cent spend 1-2 hours a week on recycling. Recent studies show that many initiatives have been undertaken, by the public, to cut down the volume of garbage flowing into the households. To illustrate, many residents refuse plastic bags and extra packaging when shopping for goods. In this survey, Question 8 asked the respondents to comment on whether they consider recycling when purchasing new articles. The result shows that 69 per cent of respondents reported that they do consider recycling when

shopping.

An attempt was also made to test the association between using the free store (USEFREST) and respondents' socio-economic characteristics. The socio-economic variable used in this test are age (AGE), education (EDUCA), employment (EMPLOY) and income (INCOME). The crosstabulation (Table 5.10) indicates that the people who reported using the "free store" are mostly those who are over 25 years old, employed and have high school, or higher, education, and a relatively low income (less than \$20,000).

Table 5.10: The Crosstabulation between Using Free Store and Socio-economic Characteristics

1) BY AGE (% of the respondents)							
	<15	15-24	25-34	35-44	45-54	>45	Total
Yes	8.51	4.26	12.77	35.11	13.88	19.15	93.62
No	0	1.06	2.13	1.06	0	2.13	6.38
2) BY EDUCATION (% of the respondents)							
	Elementary	High school	College	University	Total		
Yes	8.79	23.08	38.46	24.18	94.51		
No	0	1.10	2.20	2.20	5.49		
3) BY EMPLOYMENT (% of the respondents)							
	Employed		Unemployed		Total		
Yes	58.24		36.26		94.51		
No	2.20		3.30		5.49		
4) BY INCOME							
	<\$10,000	10,000-19,999	20,000-29,999	30,000-39,999	>40,000	Total	
Yes	20.21	44.68	12.77	5.32	10.64	93.62	
No	0	2.13	3.19	0	1.06	6.38	

Further exploration of the association between USEFREST, TIMEREC and CONSREC and the socio-economic characteristics was undertaken by reclassifying age (AGE), education (EDUCA) and income (INCOME) from ordinal data to nominal. The new age variable has low (<25), middle (25-44) and old (>44) as three categories. The education variable was regrouped into two classes: low (elementary and high school) and high (college and university). The new income variable has low (less than \$20,000), middle (\$20,000-39,999) and high (more than \$39,999) levels respectively. Fisher's exact test was then used to test the hypothesis that there is no association between using the free store (USEFREST), time spent on recycling (TIMEREC) and considering recycling when shopping (CONSREC) and anyone of the four socio-economic characteristics, because the expected frequency was less than 5 for 2x2 tables, and the expected frequency of more than 25 per cent of cells is less than 5 for the larger tables. The results are summarized in Table 5.11 by two statistics: Fisher's exact test to support, or reject, the hypothesized association and the correlation coefficient that indicates the strength of the association. The coefficients are Phi for 2x2 variable tables and Cramer's V for the larger table.

The results indicates that there is no significant association between either USEFREST or TIMEREC and any of the four socio-economic variables. There is also neither an

Table 5.11: Analysis of Associations with Socio-economic Characteristics of the Respondents

	Age	Education	Employment	Income
USEFREST				
Fisher's exact test	1.000	1.000	0.381	0.098
Phi or V	0.022	0.067	0.101	0.199
TIMEREC				
Fisher's exact test	0.836	0.659	0.644	0.164
Phi or V	0.073	0.039	0.097	0.224
CONSREC				
Fisher's exact test	0.049	0.450	0.636	0.0001
Phi or V	0.255	0.097	0.053	0.454

Note: Figure in **boldface** indicates that the null hypothesis is rejected and a significant association (95% probability) is detected.

association between CONSREC and EDUCA nor an association between CONSREC and EMPLOY. However, a significant association between CONSREC and AGE, and between CONSREC and INCOME was detected. The correlations were positive, but the coefficient indicates that they are rather weak.

The positive correlation between CONSREC and INCOME was expected, since environment-friendly products tend to be more expensive than other alternatives. Therefore, those who have higher income have the financial ability to pay more for environmental friendly products. The positive correlation

between CONSREC and AGE is probably because older people tend to have higher income, hence can afford more environmental friendly products.

5.3.3. Public Acceptance

The success of recycling depends on public participation and support. Although some studies have shown a lack of correlation between expressed attitudes and overt behaviours, positive correlation between the two has often been observed (Free, 1986). A survey of public attitudes may help to explain this positive relationship. Section C of the questionnaire was designed to examine the degree of public acceptance towards the Hornby Island recycling program. Table 5.12 summarizes the questions asked, and the form of analysis undertaken with the data they generated.

Question 1 in this section asked the respondents to rank, on a scale of 1 to 5 (1 = very successful, and 5 = very unsuccessful), the success of the Hornby Island recycling program. The result indicates that 31.4 per cent of the respondents considered the program very successful and 57.8 per cent successful.

Table 5.12: Summary Table of the Variables in Section C of the Questionnaire

Question Number	Variable Abbreviation	Type of Question	Function of Question	Form of Analysis
1	PROSUCC	Overall acceptance of the recycling program	Establish the overall acceptance rate	-Frequency table
2	PROREC CONRES REDCOST REDPOL REDTAX CREJOB	The success of some aspects of the recycling program	Establish the rating of the public about the aspects of the recycling program	-Frequency table
3	PROADMIN PROPROM	The administration and promotion of the recycling program	Establish the public acceptance of the administration and promotion	-Descriptive analysis
4	INADA INADB INADC INADD INADE INADF	The problems of the recycling program	Identify the problems, and their relative importance	-Descriptive analysis
5	OPEN	Suggestion to the recycling program	Identify suggestion for improvement	-Descriptive analysis

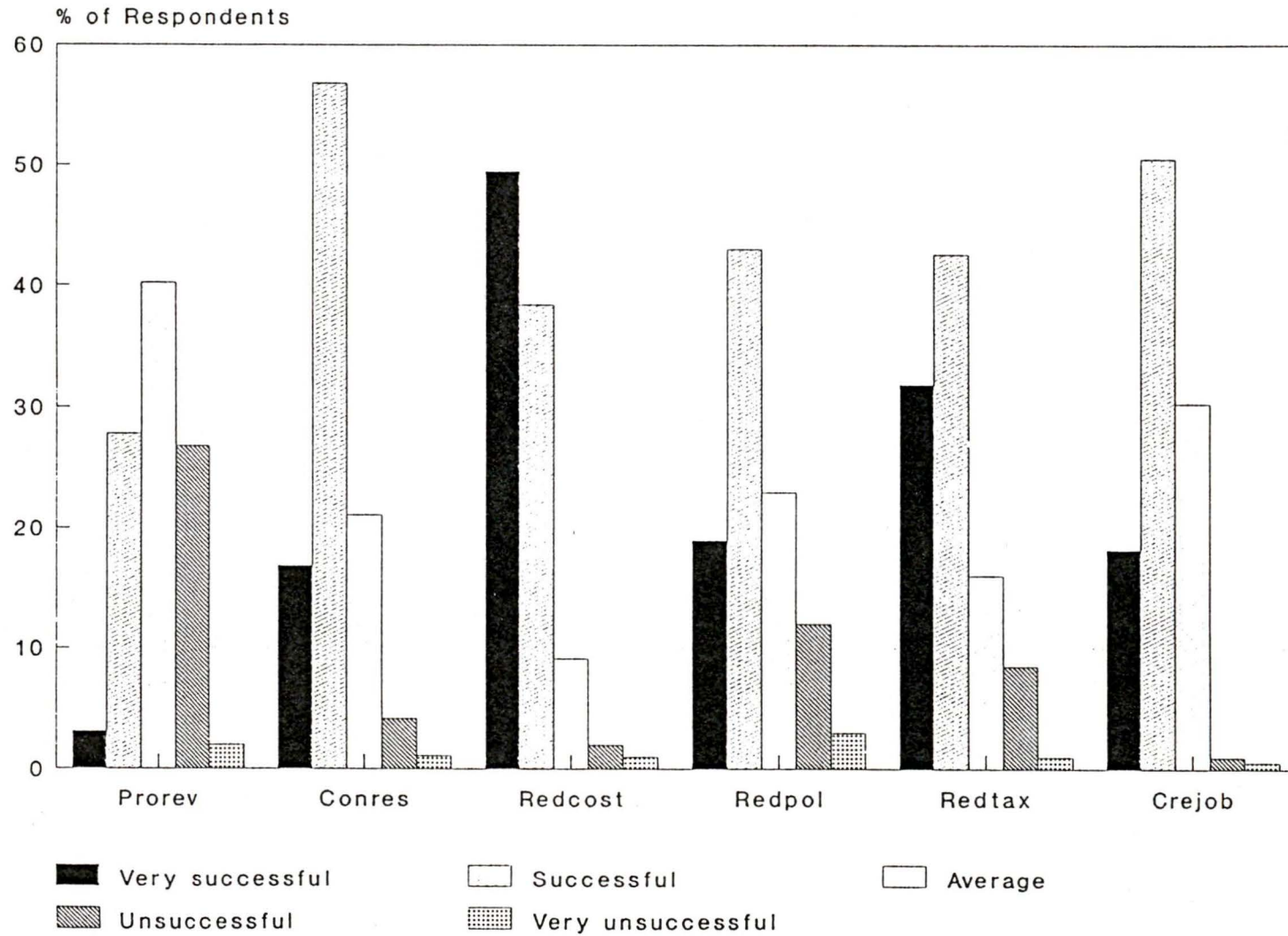
Question 2 of this section asked the respondents to rate, again on a 1 to 5 scale, those aspects of the recycling program which corresponded to the benefits reviewed in Chapter 2. These benefits were: producing revenue (PROREV), conservation and reuse of natural resources (CONRES), reducing disposal costs (REDCOST), reducing pollution (REDPOL), reducing taxes (REDTAX), and creating jobs (CREJOB). The frequency of responses to each aspect were presented in Figure 5.6, and the mean scores, standard deviations and co-efficient of variance are summarized in Table 5.13.

Table 5.13: The Mean Rating of Success of the Hornby Island Recycling Program

Benefit	N	Mean	Standard Deviation	C. V.
PROREV	97	2.97	0.8715	29.35
CONRES	95	2.16	0.7898	36.60
REDCOST	99	1.67	0.8081	48.49
REDPOL	100	2.37	1.0215	43.10
REDTAX	94	2.04	0.9606	47.03
CREJOB	99	2.14	0.7144	33.36

This analysis indicates that the most successful aspect of the program as viewed by the islanders is reduced disposal costs, followed by reduction of taxes, conservation and reuse of natural resources, creating jobs, reducing pollution, and producing revenue. These findings support the hypothesis that a recycling program can only succeed, in the long term, when financial benefits exceed the costs (Environmental Resources

Figure 5.6: The Proportion of Respondents Who Ranked some Aspects of the Recycling Program



Limited, London. 1985, and Stevens, 1988). Although the respondents ranked producing revenue last, revenue from sale of recycled material forms only a part of the financial benefits. Stevens (1988) pointed out that the revenue should include the savings in disposal costs, as well as the revenue from the sale of processed recyclable materials.

Question 3 was designed to explore public evaluation of the administration and promotion of the recycling program. On a scale of 1 to 5 (from very good to very bad), it was found that 35.7 per cent of the 98 respondents rated the administration to be very good, and 25 per cent considered it good. 43.4 per cent of the 99 respondents also rated the promotion of the program as very good, while 46.5 per cent reviewed it as good.

Question 4 asked the respondents what they consider to be the most inadequate aspects of the program. The most frequently indicated problems were the treatment of plastics, and air and groundwater pollution control. Other problems cited were the treatment of nonrecyclable materials and marketing.

Chapter 6

THE DEVELOPMENT OF THE HORNBY ISLAND RECYCLING

PROGRAM: STUDY RESULTS 2

6.1. INNOVATION PROCESS: THE DEVELOPMENT OF THE HORNBY ISLAND RECYCLING PROGRAM

As discussed in Chapter 4, in this study recycling is viewed as a community innovation. Therefore, the theory of innovation diffusion can be used to provide a theoretical framework for the interpretation of the development of the Hornby Island recycling program. Innovation is a process, a sequence of decisions, events, and behaviour changes over time (Rogers, 1986). Recent investigations of the innovation process in organizations have followed a relatively unstructured, open-ended, case-study approach of the innovation-decision process for a single innovation (Rogers, 1986). Keeping this in mind, this section attempts to trace the development of the recycling program by employing the diffusion model developed in Chapter 4. The model (Figure 4.3) was conceptualized as consisting of 8 stages, each characterized by particular types of information seeking and decision-making behaviours.

6.1.1. Problem Recognition (1976-1978)

Before the recycling program was established, Hornby Island's municipal solid waste was dumped at the site where the recycling depot is now located. Since this open dump had no permit to operate and no supervision, the islanders simply drove to the site and left their garbage. This resulted in a huge pile of waste at an undesignated location. When the garbage pile became too large and the site was overflowing, diesel oil was used to burn it. This normally took place in the fall, before winter rains (Photo 9). As the population increased, it was realized that the dump did not have the capacity to handle the quantity of garbage generated on the island. Furthermore, because of lack of any supervision, the open dump posed fire hazards to the forest, properties, and residents in the surrounding area, and caused many pollution problems. Not only did the dump generate a litter problem, it was also odorous and harboured disease-carrying vermin. There was also a growing fear that leachate from the dump could eventually contaminate the community's water supply. Consequently, the Pollution Control Branch of the B. C. Ministry of Environment considered that the dump was not acceptable and condemned its operation in 1976.



Photo 9: The Old Dump On Hornby Island (Cain, 1976)

6.1.2. Searching for Solutions (1976-1978)

Problem recognition sets off a search for alternatives, one of which may be an innovation (Foster and Sewell, 1977). The initial response of the island community to the closure of the dump was to look for an alternative landfill site, on the island, which could meet the requirements of the Pollution Control Branch of the B. C. Ministry of Environment. A committee was set up, by the Hornby Island Residents and Ratepayers' Association, to investigate potential sites. Several sites were recommended by the team; however, none was approved by the Pollution Control Branch.

Disapproval of landfilling as a waste disposal technique was mainly due to two reasons: the rapid increase of the island's population and the potential risk of groundwater contamination by any landfill. According to Brown (1988) and the Hornby Island Recycling Committee (1990), from 1974 to 1978, the number of permanent inhabitants on the island doubled from about 200 to around 400, while summer residents sharply increased from some 400 to nearly 2000. This population growth brought about many changes, amongst which was a significant increase in the amount of garbage generated. Although there were no reliable data available on the actual quantity of the garbage produced at that time, it was estimated that this was about 8 tonnes a month during the winter, and 50 tonnes a month during the summer. These

figures were derived by using the formula: $Y = .048X^{2.3}$, where Y is the garbage in tonnes produced per capita per year, and X is the contributing population. This formula was developed by the Capital Regional District for the Gulf Islands. These volumes were considered too high to permit landfilling on Hornby Island.

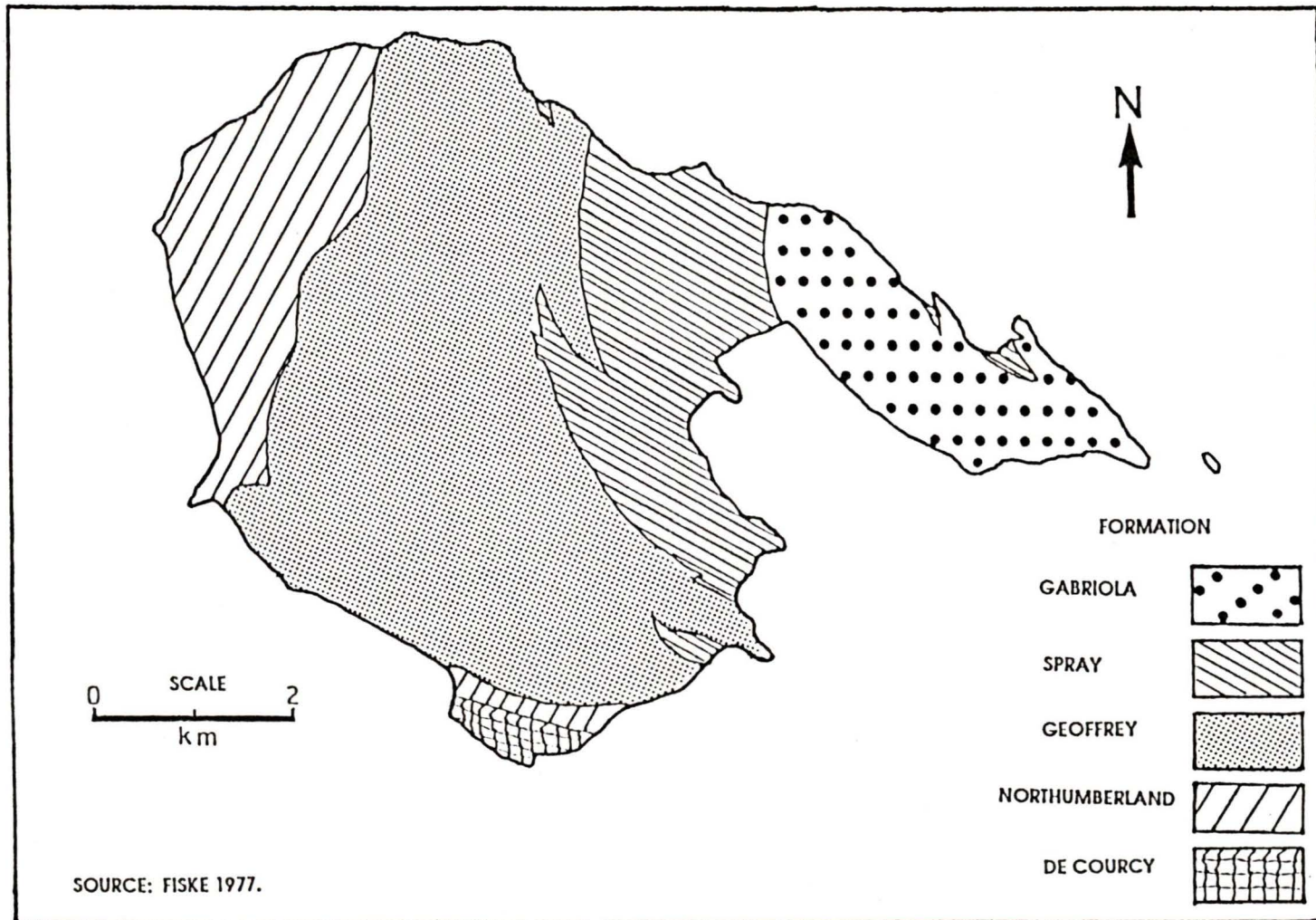
The second reason that landfills were not encouraged was the potential risk of groundwater contamination they represent. Hornby Island residents rely almost exclusively on groundwater. Most of the wells are shallow, seldom exceeding a depth of 15 feet (Lubkowski, 1972). Such wells were designed to intercept seepage running along the surface of the underlying rock, or impermeable clay. Many shallow aquifers consist of glacial tills "overlain by coarse textured marine veneer deposits" (Lubkowski, 1972). These deposits, ranging from a few centimetres to about 5 meters, mantle the bedrock over most of the island (Lubkowski, 1972). Since these shallow aquifers are nourished by local precipitation and the resultant percolation of surface water, pollution is an ever-present threat.

The potential for contamination of deeper aquifers also exists. Geologically, the island consists of deposits laid down during five successive periods of sedimentation. They are, in order of increasing age, the Gabriola Formation

(sandstone-conglomerate), the Spray Formation (mudstone-turbidite), the Geoffrey Formation (sandstone-conglomerate), the Northumberland Formation (mudstone-turbidite) and the De Courcy Formation (sandstone). Together they represent about 1,000 meters consisting of two complete and one incomplete cycles of upward coarsening (Fiske, 1977). A generalized geological map (Figure 6.1) shows these sequences and the distribution of sediments. Since most of sedimentary rocks of the island are permeable, and faults are widespread (Fiske, 1977), leachate run-off from landfills poses potential risks of contamination to deeper wells.

Hornby Island residents were already taxed for the use of the Pigeon Lake landfill at Cumberland. The Pollution Control Branch, therefore, suggested that all garbage should be trucked off the island to this Landfill, which was already used by other communities of the Comox-Strathcona Regional District. The estimated cost of collecting and disposing of the island's garbage at the Pigeon Lake landfill at that time was approximately \$85,000 a year. In order to avoid these high costs, the community started a search for an alternative solution to its garbage problem.

FIGURE 6.1: HORNBY ISLAND SEDIMENTATION



6.1.3. Awareness of Innovation (1978)

Recycling is not a new phenomenon. Although never a major industry, recycling from household wastes was a way of life until the mid-twentieth century. However, at that time, many technological, economic and social constraints resulted in the decline of recycling (National Centre for Resource Recovery, Inc. 1974). The conservation and environmental movement of the 1960s and 70s generated new pressure to stimulate efforts to recycle. As stated by Dr. Richard Leshner, President of National Centre for Resource Recovery, Inc. (1974:2).

We have experienced the movement from the an age of abundance to an age of scarcity. The immediate and direct impact of the shortage of many of our basic materials is an increase in the price level of both materials and fuel sources. What this is doing is providing the profit opportunity and momentum for resource recovery.

In the United States, with passage of the Resource Recovery Act of 1970, attention was focused upon the prospect for the widespread recovery of valuable materials from solid waste. Growing public awareness of conservation and the environment, and of the problems associated with municipal solid waste handling and disposal have stimulated interest in recycling. As a result, many recycling programs were established to conserve natural resources during this period.

Clearly, new ideas must be communicated before the adoption of any innovation can be considered (Foster and

Sewell, 1977). Several well-informed residents, some of whom were members of the committee set up by the Hornby Island Residents and Ratepayers' Association to look for alternative solutions, became aware of recycling as an alternative method of municipal solid waste management. They proposed that a recycling program be started to tackle their municipal solid waste problems. The Residents and Ratepayers' Association accepted this recommendation and decided to let the group try and see what could be done in the way of recycling.

6.1.4. Matching the Innovation with the Problem (1978)

When the program was initiated in 1978, its main objective was to reduce the volume of municipal solid waste by recycling so that it could be dealt with at the old dump site (Cain, 1978). A Recycling Committee, made up of volunteers, was set up. The members of this committee and some volunteers took on the organization and management of the program. Under the recycling committee, a depot operator was hired to manage the operation.

The first task of the program was to turn the dump into a recycling depot. Many volunteers, especially the members of the recycling committee, participated actively in this initial struggle. The old garbage was bulldozed to side after the bottles and cans were taken out, leaving a large cleared site. A shed was built for a free store for reusable items.

A 4 x 4 meter concrete platform was poured on which to keep barrels for the recycled materials, mostly glass and cans. One side of the depot was made into collection sites for large appliances and discarded vehicles. On the other side were a site for scrap metals, and a series of boxes used for composting. A sheltered box was also placed on the site for the burnable and a burner was used to destroy them.

While the volunteers were sorting the old dump pile, residents were asked to cooperate by separating their garbage into three categories: tin-cans, bottles and jars, and anything dry that would not burn; combustible materials including plastics; and kitchen waste, disposable diapers and anything wet. After these sorted materials were delivered by the residents to the depot, under the supervision of the depot operator reusable items such as clothes, footwear, small appliances, wine bottles, and canning jars were put into the free store. Labels and lids were removed from glass which was then sorted into clear, green and brown types. It was then smashed into barrels by hand. After cleaning and removal of labels, the tin-cans were flattened by hammer and stored in drums. The paper products, plastics and disposable diapers were burnt. Kitchen waste was composted in compost boxes and the rest were landfilled.

Since the site was not gated at that time, many people left unsorted garbage after closing hours or when the depot operator was unavailable. The depot operator then had to go through these garbage bags and separate the recyclable materials.

Two points are worthy of comments at this stage, the roles played by key individuals and the modification of the innovation. The program was initiated by a few individuals who were instrumental in making the program successful. Indeed, their promotion of the program was one of the most important factors in guaranteeing the success. Their personal characteristics and influence will be further discussed in the next section. The second point of interest is that Hornby Islanders only accepted recycling as a concept and modified it in the process of adoption. This point will also be discussed in more detail later.

6.1.5. Trial (1978-1979)

Once the innovation was adopted, an initial trial period followed. According to Foster and Sewell (1977), in most instances, potential adopters will want to experiment on a limited basis before deciding whether or not to accept permanently and wholeheartedly. This is especially true in the case of innovations which are expensive, or would require a significant departure from existing norms, involving perhaps

a differing lifestyle. This was found to be true in the case of the Hornby Island recycling program. This program started as an experiment to see what could be achieved by recycling. It was decided then that if the trial succeeded, the Hornby Island Residents and Ratepayers' Association would petition the Regional District to relieve Hornby Island's share of taxes for the Pigeon Lake landfill, estimated to be close to \$3,000, and apply for a grant of \$3,800 for the depot from the Pollution Control Branch, Ministry of Environment of British Columbia.

In its initial stages, recycling requires public participation and changes in lifestyles. Although some residents accepted the idea of recycling with enthusiasm, most appeared to resist the change by refusing to sort their garbage. The participation rate in the initial stage was estimated, by the people who were involved in the operation of the program at that time, to be about 20-30 per cent. In order to improve participation, many methods such as letters to the newsletter, brochures, talking to people and even door-to-door visits were employed by the recycling committee members and dedicated volunteers.

Through the extensive efforts of the recycling committee and hard-working volunteers, the experiment enjoyed some initial success that was acknowledged by the Hornby Island

Residents and Ratepayers' Association. As a result, the landfill tax was relieved and the grant was approved, officially establishing the program in 1979. At that stage, a recycling coordinator was appointed besides the depot manager.

6.1.6. Implementation (1979)

After its initial success during the trial period, the recycling program entered a longer, sustained implementation stage. Great effort was made during this period to establish recycling as a way of life on Hornby Island. The struggle to erect a gate at the depot entrance was an example of such effort.

As a consequence of unregulated operation at that time, a large amount of unsorted garbage sometimes overwhelmed the staff and had to be burnt and landfilled. There was a danger that the recycling depot would soon become a dump again. In September 1980, the recycling committee asked the Regional District, through the Hornby Island Residents and Ratepayers' Association, to draft a regulation giving authority to regulate the delivery of sorted materials to the depot. The Recycling Committee proposed that: 1) a gate should be installed at the entrance and opened at limited times for disposal of sorted refuse, in an acceptable condition; 2) a prescribed charge should be levied for unsorted garbage; 3) a

fine based on littering laws of the province should be given to individuals refusing to cooperate; and 4) littering should be charged against anyone leaving refuse outside the gate, at the roadside or in any other public place.

In October 1980, the Hornby Island Residents and Ratepayers' Association approved a by-law to give the association the right: 1) to charge up to \$5 a bag for unsorted garbage; 2) to refuse the garbage if it was too filthy to handle; 3) to deny anyone the right to bring garbage from off-island and to dispose of it at the depot; and 4) to levy a fine of up to \$100 against those who refused to follow regulations set by the association.

These proposed regulations and by-laws stirred up a heated debate, which was reported in The First Edition and was conducted at ratepayers' meetings. Those who opposed such regulations argued that the gate would present more problems than it would solve, since it would encourage dumping of garbage along roads and inconvenience those who could not take the advantage of opening hours. It was also argued that the imposition of a charge and fines was improper, because the decision as to what was to be taken to depot was an individual right, and that cooperation in recycling should be strictly voluntary. It was also urged that the recycling committee fully staff the depot and take care of whatever reached it.

This might involve burning and landfilling unsorted garbage, and trucking off the island any residue. Because of this significant resistance, enforcement of the regulations was postponed.

Those who were in favour of the new regulations launched a campaign to promote the benefits of regulations. Members of the recycling committee, especially the recycling coordinator, used the local newsletter, pamphlets, householder mails, and local meetings to explain the problems the depot was facing and pleaded for cooperation. They argued that recycling would save around \$60,000, which would have to be spent if garbage was trucked to Pigeon Lake. They emphasized the improvement over the old dump operation. Members of the recycling committee even made door-to-door visits to show how simple it was to sort their garbage.

A gate was finally installed on March 1, 1981. In addition, a notice of the depot's hours of operation, its sorting regulations, and the names of the recycling committee members responsible for the program and sorting regulation were published in The First Edition of February 1981.

Regular hours and attempts to increase the quality of sorted waste materials met with an enthusiastic response and the cooperation of most residents. As a result, by February

1982, one year after the erection of the gate, the program was greatly improved and the amount of unrecycled (landfilled) materials was greatly reduced. Furthermore, 35 tonnes of glass, 30 tonnes of flattened cans and scrap metal were recycled. The free store also proved to be a very successful element of the depot and many useable items were reclaimed through it. Hornby Island's recycling efforts became known to visitors and many other communities. Government officials, recycling group representatives, reporters and other interested parties came to the recycling depot seeking information.

6.1.7. Institutionalization (1986)

The acceptance of the regular operation of the depot by the majority of residents indicated that the recycling program had entered the institutionalization stage. Recycling was no longer viewed as an alien element in the community, but rather as a valuable feature of island life. Residents started to take their relatives and visitors to the depot to show them what a wonderful recycling program they took part in.

Although the program experienced obvious success, it was also affected by problems, notably weak markets for recycled goods and vandalism at the depot. The recycling crew adopted various measures to deal with first of the problems. For

instance, they encouraged residents to use broken glass as gravel for levelling and landfilling. They expanded the free store to handle a greater variety of items. They bought a tin-can crusher to compress cans into drums, so that more cans could be loaded easily into the truck, so making it more efficient and economical to transport them to market. An economic incentive was introduced to attract residents to participate. For every pound of cleanly sorted material, the depot gave a 5 cent donation, in the name of the participant, to the community hall building program. In an attempt to address the second problem, the recycling committee and depot constantly publicised vandalism and shoplifting at the depot and asked for cooperation to prevent them through the local newsletter. All these measures and constant communication with the residents and visitors greatly improved the participation and recycling rate. The Hornby Island Recycling Committee estimated that by September 1986, a recycling rate of 75 per cent was reached (Biggins, 1986).

6.1.8. Hindsight Evaluation (1988-1989)

The hindsight evaluation stage occurs only after an innovation has been widely adopted. In it, manufacturers, consumers, and other actors in the diffusion drama appraise past performance. Satisfaction is assessed and decisions are made concerning continued utilization in the present form, modification or possible abandonment (Foster and Sewell,

1977).

Despite the success of the program, market fluctuation still hindered participation of residents. During weak markets, more mixed garbage reached the depot and the amount burnt increased. A survey of the problem was undertaken by the Recycling Committee, from July 19 to August 8, 1988. It was found that 2755 bags of garbage, weighing an average of 6.4 Kilograms (or 14 lbs) each, were burnt during this three week period. The burning, especially of plastics, produced air pollution and generated a lot of public concern. As a result, a series of debates and arguments were presented in the newsletter and in local meetings.

While it was recognized that burning of plastics was a problem, views about how to improve the situation varied. Some individuals wanted to continuously burn plastics as they reach the depot. They presented some expert findings that small-scale burning of plastics did not produce a significant pollution problem. Other considered that the burner was too primitive resulting in incomplete burning and resultant air pollution. They argued that a modern incinerator should be purchased to replace the old ones. Others wanted to ship the plastics and other nonrecyclable materials to the Pigeon Lake landfill.

A questionnaire survey conducted in late 1988 by the Hornby Island Recycling Committee, provided an overview of community positions on this problem. The questionnaire survey asked 13 questions regarding different options for dealing with plastics. Responses to each question varied from 98 to 105. The results of the survey are summarized in Table 6.1. Interpretation of the table indicates that over 90 per cent of respondents considered that the handling of plastics by the depot was unsatisfactory. Between 55 and 68 per cent of respondents were opposed to burning, landfilling, and baling and stocking. A large majority, over 80 per cent, of the respondents was strongly in favour of cutting down and eliminating overuse of plastics on the island. Some 75 per cent also supported accumulating the plastics for safe disposal in the future.

On August 30, 1988, a special meeting to discuss plastics disposal was organized by the Hornby Island Residents and Ratepayers' Association. This meeting was attended by 52 people including the author of this thesis. At the meeting, the possibility of continued burning, modern incineration, composting and trucking off the island were debated. Several agreements were reached: 1) the island should take full responsibility for its own garbage and must not export the problem to other communities; 2) measures should be taken to cut down, as much as possible, on plastic use and to eliminate

Table 6.1: The Summary of the Questionnaire Survey on Plastic Burning by the Hornby Island Recycling Committee (1988)

Variable	No. of response	Response		
		Yes	No	Not Sure
Continue current practice	102	6	95	1
Continue burning	98	17	67	14
Landfilling	99	23	55	21
Baling and stocking at extra cost	101	18	60	23
Refuse acceptance by the depot	102	10	86	6
Accumulate for future disposal	102	59	23	20
Cutting down and eliminating	101	83	10	7

styrofoam on the island; and 3) a technical committee should be set up to research the problem and options for its solution.

As a result of the associated debate and meeting, the recycling depot stopped burning plastics in October, 1988. A drive was also initiated to cut down plastic use by refusing excess packaging. Residents were encouraged to use paper bags, or to carry their own baskets when shopping. The co-op store was encouraged to stock products in cardboard, glass and bulk instead of in plastics, and restaurants were asked to eliminate plastic utensils and food containers. At the time, the depot started to accumulate plastics in a designated area, in the hope that they could be reclaimed in the future.

However, the plastic pile soon became too big and had to be buried. This generated a new problem.

Evaluation was carried out as these new measures were undertaken. As Foster and Sewell (1977) proposed, it may involve greater individuality, fortitude and initiative to resist the further diffusion of the innovation at the stage of hindsight evaluation than to promote it. It was found that some people, including individuals actively involved in the initiation and development of the program, started to resist further changes at this stage. A new force, however, emerged to push for further modifications to the program.

At the end of the evaluation, a decision was made to modify the program. In Spring 1989, a new team took over the recycling program, and a decision was made to start recycling plastics and further cut down the amount being landfilled and burnt. As a result, the depot started to recycle plastics in May 1989. Residents were asked to clean and separate their plastics and deliver them with other recyclable materials to the depot. There plastics were further sorted and processed. Very quickly, a full-scale plastic recycling program took shape.

To further reduce landfilling and burning to the minimum, the depot also began to recycle cardboard and rag materials.

The depot operators also denied public access to the burner and increased its supervision. Supervisors began to check all garbage reaching the depot. The Recycling Committee also started to improve facilities at the depot. A baler to bale plastics and cardboard was purchased. A glass grinder and a better burner constructed. With a federal grant, a composting program to divert kitchen and yard waste from the burner and landfill was initiated. Problems associated with toxic and hazardous materials were publicized and residents were asked to deliver them directly to operators, to make sure they were properly handled. However, toxic and hazardous materials still remain a serious problem because the depot does not yet have a permit to deal with them. In the future, the recycling committee also plans to get electric power supplied to the depot, and to have a well drilled for fire protection. The committee is still seeking a licence of operation for the depot.

These changes required more public participation. While the majority of the islanders welcomed the expanded recycling program, some thought it was much too onerous. To promote it, a public relations committee was established, in the fall of 1988, to improve public participation. Under the leadership of the Recycling Committee, a depot day and a supporting-recycling dance were organized to publicize the program and collect funds for the recycling program. One of the most

interesting events organized by the Public Relations Committee was the depot day held on August 5, 1989 (Photo 10). During the depot day a fashion show was held using costumes from the free store. Craft and exhibits made of recycled materials were displayed. The day also featured games, recycling poster displays and workshops. It was colourful and successfully attracted many visitors.

By May 1990, when the author last visited the island, the recycling program had become an efficient, comprehensive multi-material recycling enterprise. While attempts are continuing to improve the recycling program on the island, efforts are also being made to encourage other communities to embark on recycling. The recycling program has entered a further stage in the diffusion process, as attempts are made to export this innovation to other communities. This new stage which has never been studied with respect to recycling will be discussed in the next section.



Photo 10: The Recycling Fair (Cain, 1989)

Top: The Recycling Display

Bottom: Fashion Show With Costumes From The Free Store

6.1.9. EXPORTING OF THE INNOVATION

Attempts to use Hornby Island recycling as a demonstration program began in earnest in August 1989 when the recycling committee initiated two petitions which urged the other communities in the surrounding area to encourage the provincial government to deal with problems faced by recycling. For example, in the petition to the provincial government, they recommended: 1) building of a transfer station for recyclable materials, in a central location on Vancouver Island. This was to allow an increase in supply making transport to markets more economically feasible; 2) establishment of hazardous waste disposal facilities with easy and convenient public access; 3) placing of legislative restrictions on wasteful plastic packaging and 4) mandatory coding of plastic products, make it easier to separate recyclable from nonrecyclable plastics. The committee also wrote letters to government representatives, and talked to representatives of other communities about organizing recycling programs.

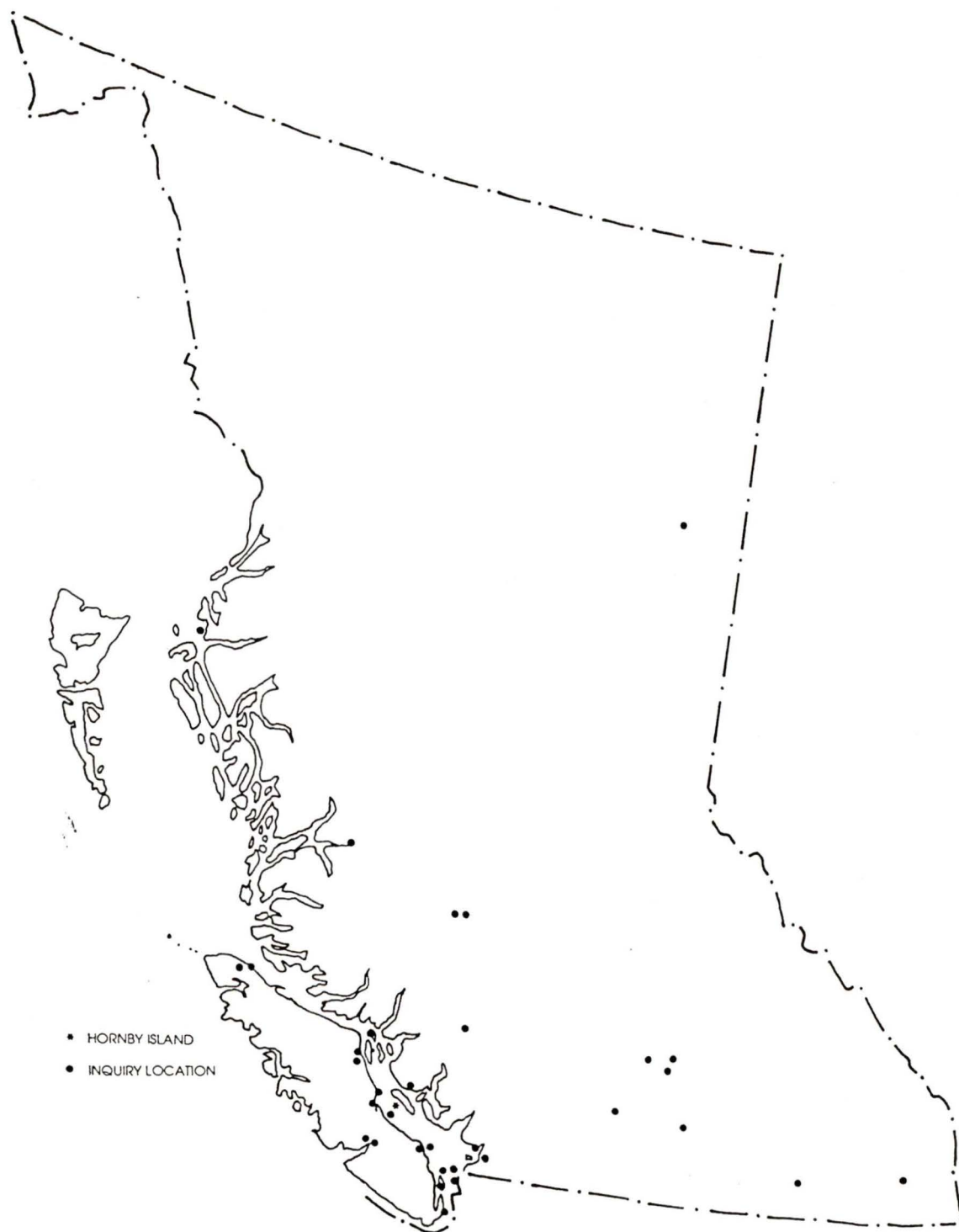
The influence of the Hornby Island recycling program has been increased by wide media coverage and numerous visitors who have been exposed to its impact. In the past two years, for example, the Hornby Island recycling program has been featured on national television and radio and in several local newspapers. Many government officials, recycling

representatives of other communities and school groups visited the recycling depot to collect information. Every year, thousands of visitors spend time on Hornby Island. They are given recycling brochures on the ferry and asked to cooperate in the operation of the program. Many of them are taken to the depot by their hosts. It is thought that a majority of the visitors participate in the recycling program while visiting the island. As a result of this exposure, these visitors may be more receptive to supporting recycling in their own communities. Although it has proven impossible to quantify the number and length of their visits to the depot, their origins were estimated after talking to the local businessmen. It was estimated that about 75 per cent of visitors to Hornby Island are from British Columbia, 10 per cent from Alberta, 10 per cent from the Western United States and the remaining 5 per cent from more distant locations.

The Hornby Island recycling program also exerted influence by diffusing literature in answers to inquiries from other communities. As interest in recycling increases in North America, more and more small communities are writing and calling Hornby Island for advice. The limited record of this contact, kept by the recycling committee, shows that in 1989 36 formal inquiries have been received and answered. These were received from as far away as Windsor, Ontario and Tantallon, Nova Scotia. British Columbia communities sending

inquiries in this period are located on Figure 6.2. There is no doubt that the Hornby Island recycling program has influenced some other communities, and has often promoted recycling activities. This process raises a question for future innovation research: is it a typical stage in the diffusion process?

Figure 6.2: The Locations of the Inquiries Originating in British Columbia (1989)



6.2. IMPORTANT FACTORS IN THE INNOVATION PROCESS

Why did recycling proceed so quickly on Hornby Island while the majority of other Canadian communities did not adopt it, and why did the Hornby Island recycling program succeed while most of the other operations originating in the late 1960s and early 1970s failed? An attempt will now be made to answer these important questions.

As reviewed in chapter 4, previous studies (Agnew and Brown and Herr, 1978, Foster and Sewell, 1977, and Kemp 1982) have identified some key ingredients which affect the adoption of an innovation by any community (Table 6.2). These factors

Table 6.2: Factors Affecting Community's Adoption of an Innovation

-
- (1) Agnew and Brown and Herr (1978)
 - The decision of a local governing body to establish an administrative agency associated with the innovation
 - (2) Foster and Sewell (1977)
 - Social contexts
 - a) Cultural setting
 - b) Stage of economic development
 - c) Level of technological progress
 - d) Industrial structure
 - e) Nature of political institutions
 - f) Cultural setting
 - (3) Kemp (1982)
 - The need, or incentive, for innovation
 - The mechanism for bringing innovative alternative into the decision making program
 - The absence of organizational barriers to implementation
-

can be subdivided into four categories: 1) the need for the innovation, 2) the establishment of a diffusion agency, 3) the socioeconomic characteristics of the community and 4) the decision-making process. This section tries to analyze the influence of these and other factors upon the adoption of recycling on Hornby Island.

6.2.1. The need for recycling

Need was perhaps the most important factor influencing the community's decision to adopt recycling as its chief method of municipal solid waste management. For local initiative innovations, need can only be defined once certain local threshold conditions have been met (Agnew et al. 1978). The closure of the old dump and the inability to obtain provincial approval for a new landfill generated this threshold condition on Hornby Island. Islanders were forced to search for alternatives, one of which was recycling. After a short trial period, this was quickly adopted as the best solution to the garbage disposal problem.

The adoption of recycling on Hornby Island confirmed the views of Kemp (1982) and Knight (1967). Kemp stated that the adoption of a needed innovation occurs much more rapidly than one which appears to be purely an amenity. Knight suggested that organizations in a state of constant crisis, will have little time and resources left to consider innovations which

will not alleviate critical problems. In consequence any changes will tend to be internally directed-organizational, or cost-reducing. The chief motivation of the Hornby Island recycling program was cost-reduction. This economic stimulus, rather than any ecological considerations may help to explain why the Hornby Island recycling program has succeeded, while most of the others which originated at that time failed. It seems likely that other programs were primarily based on ecological philosophies rather than on economic necessity (Stone, 1988).

6.2.2. Establishing a diffusion agency

A central factor in the community innovation process is the decision, by a local governing body or agency, to establish an administrative agency to disseminate the innovation within the community (Agnew, Brown and Herr, 1978). The new agency conceives and implements a strategy to promote the adoption of innovation. This was true of Hornby Island where the establishment of the recycling committee was an extremely important factor in the development of the Hornby Island recycling program. This is because it has been a constant driving force for the program.

Brown (1981) identified four major activities: the development of infrastructure and organizational capabilities, pricing policy, promotional communication and market selection

and segmentation as the key activities of a diffusion agency. However, only the first two of these activities were found to be relevant in the case of the Hornby Island recycling committee. The development of infrastructure and organizational capabilities, for example, included the setting up and management of the recycling program, and drafting and enforcing regulations. Constant promotional communication by the committee also appeared to be a major factor in generating publicity and promoting acceptance of the program. This in turn greatly contributed to the success of the program.

6.2.3. Key individuals

Innovation is a profoundly social process, so it is important to examine the key social roles that govern the speed and adequacy of implementation (Rogers, 1986). The Hornby Island recycling program was initiated by several individuals who were instrumental in making recycling successful on the island. Their efforts in starting and promoting the program were found to be an important factor in its success. The pace of adoption and diffusion of an innovation depend upon the personal characteristics of individuals who exerted influence upon it (Foster and Sewell, 1977). Therefore, an understanding of the characteristics of these individuals and of their motivations is essential to an understanding of the adoption and development of the recycling program on Hornby Island.

In their early work, Rogers and Shoemaker (1971) suggested that for an innovation to occur within a organization, it is necessary to have three key individuals who perform different roles in communicating the new idea to the organization. The 'stimulator', generally someone outside the organization who has extensive external contacts, plants the seed of awareness. The 'initiator', often an insider who is familiar with the working of the organization and realizes that the innovation can provide a means of narrowing an existing 'performance gap' between the organization's expectations and its actual operation, incorporates the innovation into a specific plan of action. And the 'legislator', who has authority or high visibility, supports the idea and lends credibility to the initiator's suggestions. In the case of the Hornby Island recycling program, it was difficult to identify those three individuals, especially the 'stimulator', because the program was initiated by several individuals, most of whom remained active throughout the development of the program. Nevertheless, several individuals could be identified as 'initiators', 'promoters' and 'supporters' of the recycling program.

'The recycling innovators' were individuals who played an active and creative role in the initiation process. They matched the community's municipal solid waste disposal problems with recycling, introduced recycling to the community

and planted the "seed of innovation". In some respects, they played the role of the 'innovator' identified in previous studies (Rogers, 1971 and Kemp, 1982).

Rogers (1988 and 1983) found that agricultural innovators were venturesome, daring, eager to try new ideas, controlled substantial financial resources and had the ability to understand and apply complex technical knowledge. They were also characterized by high levels of formal education, income and social status. The initiators still resident on Hornby Island were interviewed. It was found that they were mostly 30-40 years old, with some college education, well-travelled and informed, with extensive external contacts. They were generally self-employed with low incomes (mostly less than \$20,000). Most of them had some urban background and had rejected city life, because they wanted more personal control and greater contact with nature. Although these findings generally confirm those of Rogers, an exception was observed, that is, the initiators had relatively low income. This difference was perhaps due to the relatively low financial investment and risk of the recycling program, and because a recycling depot can be used as a resource centre to reclaim reusable items and materials. It must also be remembered that the innovation was designed to save money and not private investment.

During the interviews, an attempt was also made to examine the motivation of the innovators for starting the recycling program. It was found that they were economically motivated. They wanted to deal with the island's municipal solid waste in a most economical way to divert useful materials from the waste stream. Furthermore, they were very conscious of the environment. They were also very dedicated and wanted to take full responsibility for their own municipal solid waste.

'The recycling promoters' were the innovators and some early adopters of the recycling program, who welcome the new idea with enthusiasm, and actively participated in, and promoted the program. Their efforts greatly speeded up the adoption of recycling by the island population.

'The recycling supporters' were some executive members of the Hornby Island Residents and Ratepayers' Association. They were of high social status and were respected in the community. As a result, their decision to accept recycling gave legality and official support to the program. Therefore, in many respects, they played the role of the 'legislator' in Rogers' studies.

6.2.4. Social and economic characteristics

The adoption of a community innovation depends not only on key individuals but also on the characteristics of the population as a whole. Rogers et al (1988), in their studies of agricultural innovation, classified population into five adopter categories and summarized their characteristics (Table 6.3). However, in the present study of the Hornby Island recycling program, it was impossible to examine these five adopter subgroups, because of the lack of adequate information on the temporal aspects of the diffusion of innovation which is necessary to explore the adopters' characteristics. Nevertheless, an attempt was made to analyze the cultural history of island, and the social-economic characteristics and attitudes of the current island's population, to shed some light on their influence upon the innovation process.

6.2.4.1 Cultural history

According to Brown (1988), Hornby Island was first settled by the white people in the 1860s. By 1937, the population reached about 125 to 200. These early settlers were mainly engaged in seasonal farming, fishing and logging. Men followed employment anywhere along the coast. Their families moved with them, or remained on Hornby using it as a home base. Since the 1960s, the island's population has been increasing. New residents came from a variety of backgrounds. Most of the 'new-comers' were young and well-educated.

Table 6.3: Characteristics of Adopter Categories

CHARACTERISTIC	INNOVATORS	EARLY ADOPTERS	EARLY MAJORITY	LATE MAJORITY	LAGGARDS
1. Time of adoption	First 2.5 percent to adopt new ideas	Next 13.5 percent to adopt	Next 34 percent to adopt	Next 34 percent to adopt	Last 16 percent to adopt
2. Attitudes and values	Scientific and venture-some	Progressive	More conservative and traditional	Skeptical of new ideas	Conservative beliefs; fear of debt
3. Education and abilities	High level of education; ability to deal with abstractions	Above average education	Slightly above average education	Slightly below average education	Low level of education; difficulty in dealing with abstractions
4. Group memberships	Leaders in country-wide or state organizations; travel widely	Leaders in local organizations	Many informal contacts within the community	Little travel out of community; little activity in formal organizations	Few memberships in formal organizations other than church; semi-isolates
5. Social status	Highest social status, but their farming practices are not respected locally	High social status; neighbors regard as "good farmer"	About average social status	About average social status	Lowest social status
6. Farm businesses	Largest, most specialized, and most efficient	Large farms; slightly less specialized and efficient	Slightly larger than average-size farms	Slightly smaller than average-sized farms	Small farms; low incomes; seldom farm owners
7. Main sources of information about agricultural innovations	Scientists; other innovators; research bulletins	Highest contact with local change agents; farm magazines; extension bulletins	Farm magazines; friends and neighbors	Friends and neighbors	Mainly friends and neighbors; radio farm shows

Source: Rogers, et al. (1988).

Some came from cities in search of natural and unpolluted environment, and simpler, freer and do-it-yourself-on-the-cheap life. Others turned away from the expensive living of cities, or from the lines of the unemployed, to look for an alternative and simpler, less expensive life style. Although the population includes a wide social spectrum, because of its relatively isolated geographical location, those who came to Hornby Island tended to like an unpolluted environment and a simpler, more natural, and less expensive life. This cultural tradition is in favour of recycling.

6.2.4.2. Local decision-making process

The local decision-making process also tends to favour innovation. On Hornby Island, there is no formal government; decisions are made through the Hornby Island Residents and Ratepayers' Association, by majority voting. The local decision-making process avoids the bureaucracy of 'large' organizations and speeds up the innovation process. Because decisions are made by local people, there is a better matching of innovation with the local situation, so increasing the likelihood of rapid adoption.

6.2.4.3. Social and economic status of the population

An understanding of the characteristics of the population is essential in any study of the innovativeness of a community. To this end, the last section of the questionnaire

was designed to gather information on the respondents' social and economic characteristics. Results were compared with the mean of the British Columbian population to see whether islanders formed a distinct subgroup (Table 6.4).

A Chi-square test was used to test whether there was a significant difference between the questionnaire respondents and the population of British Columbia in terms of age, education, employment and income. It was found that there was a statistically significant ($\alpha=0.05$) difference in age, education and income. However no difference existed in levels of employment. The respondents tended to have higher levels of education and lower incomes than residents of the province as a whole. There were also more middle-aged (35-44) and fewer young (younger than 24) people amongst the respondents.

6.2.4.4. Attitudes

According to Fishbein (1983), an individual's attitude towards any object is a function of his or her beliefs about the object and the evaluative aspect of those beliefs. When an individual's attitude is positive, it is likely a preference for that object can, or will, be stated. Rogers et al. (1988) and Rogers (1983) also suggest that an individual's attitude about innovation greatly influences his or her passage through the innovation process, since attitude is a relatively enduring organization of an individual's beliefs

Table 6.4: The Comparison of Social and Economic Characteristics among the Population on Hornby Island and In B. C.

	Hornby Island	B. C.	Chi-square
Age			
1-14	9.5	20.2	5.3844
15-24	5.3	14.3	5.3811
25-34	14.7	17.3	0.3712
35-44	35.8	15.5	25.2571
45-54	13.7	10.5	0.9265
55 or over	21.1	22.2	0.0518
Number of responses (95)		<u>Subtotal:</u>	37.3721
Education			
Elementary	8.7	11.4	0.6075
High school	25	41.4	6.1718
College and over	65	44.5	8.9716
Number of responses (92)		<u>Subtotal:</u>	15.7509
Employment			
Yes	59.8	64.9	0.3807
No	40.2	35.1	0.5240
Number of responses (92)		<u>Subtotal:</u>	0.9047
Family income			
less than \$10,000	21.1	4.7	54.3643
10,000-19,999	46.3	17.7	43.9018
20,000-29,999	15.8	15.9	0.0006
30,000-39,999	5.3	10.6	2.5175
40,000-49,999	5.3	16.5	7.2223
50,000-59,999	0.0	11.3	10.7350
over 60,000	6.3	15.3	5.0294
Number of responses (95)		<u>Subtotal:</u>	123.7709
		<u>TOTAL:</u>	(177.799)

Source: 1990 Canada Year Book.
Census Canada. 1986.

that predisposes his or her action. Even though attitudes do not always correspond to, and may even be contradictory with, actual behaviour, the practical utility of knowing an individual's attitudes is that they provide a partial basis for predicting behaviour. Therefore, section D of the questionnaire was designed to measure the attitudes of the respondents towards recycling.

Two methods are often used to measure attitudes. The first one is a scaling technique, which asks the respondents to rate the attributes on a scale of 1 to 5. According to Andressen (1987), structured attitude scales are generally accepted as the most valid way of measuring attitudes, and have been widely used by geographers. The second method is an ordinal technique of ranking orders, in which the respondents are instructed to rank the attributes in order of their relative importance by assigning a numerical rank 1 to the most important attribute, a 2 to the second most important, and a n to the least important attribute. Lemon (1973) claimed that this is an effective way of making relative judgement to rank order a set of statement or objects. In her study of Japanese tourists, Andressen (1987) found that both methods are highly correlated, providing basically an equivalent measure of relative importance of the attributes.

The questionnaire data obtained from rating was analyzed by mean score, standard deviation, and co-efficient of variance. Question 1 of Section D asked the respondents to check, on a scale of 1 to 5 (from very good to very bad), their preference for the four most common municipal solid waste disposal methods. The analysis is summarized in Table 6.5 and indicates that the respondents were strongly in favour of recycling and composting over incineration and landfilling.

Table 6.5: The Preference of the Respondents over Different Disposal Methods

Method	Number of Response	Mean Scale 1-5	Standard Deviation	Co-efficient of Variance
Landfill	98	3.95	1.02	25.81
Incineration	98	3.46	1.13	32.73
Composting	98	1.64	0.96	58.14
Recycling	100	1.15	0.44	37.84

The data obtained from ranking were analyzed by the Kendall Coefficient of Concordance W . According to Siegel and Castellar (1988) and Kendall (1970), W is used to express the degree of association between k sets of rankings. Therefore, W is an index of divergence of the actual agreement shown in the data from the maximum possible or perfect agreement. Such a measure may be particularly useful in the studies of interjudgements, or interest reliability and also has

applications in the studies of clusters of variables. W varies from 0 to 1, 0 representing no community of preference, while 1 or unity represents perfect agreement. In other words, a high or significant value of W may be interpreted as meaning that the k observers are applying the same standard in the ranking of the n objects.

Because of the isolated geographical location and unique cultural background of Hornby Island, a homogeneity of its population was hypothesized. Therefore, after deleting the missing values, the first step of the analysis was to test the hypothesis that the respondents have no community of preference in the ranking of the attributes surveyed in Section D of the questionnaire. If W was not found to be significant, it was then not justified to find an estimate of a true ranking, for it is not at all certain that such a true ranking exists. If W was found to be significant, the next step was to estimate the true ranking of the attributes. The ranking was done by ranking them according to the sum of the ranking, or the mean of ranking, assigned to each attribute, the one with the smallest sum being ranked first, the one with the next smallest sum being ranked second and so on (Ostle 1963, Siegel and Castellar 1988). Although this numerical approach to a nonnumerical variable cannot be literally interpreted, it should provide a good assessment of the relative importance of the attributes.

Question 2 asked the respondents to rank, in the order of importance, the factors which should be considered when dealing with municipal solid waste. The result (Table 6.6) indicates that W is significant enough to reject the null hypothesis. Therefore, there is considerable agreement amongst the respondents in the ranking of these factors. It is interesting to note that the respondents placed environment and human health before cost as the most important factors. This shows that the public have become so concerned about the environment that they are willing to pay more to protect it. This result was further confirmed by responses to Question 7, which illustrated that 87 per cent of the 98 respondents were willing to pay a higher tax to support a good recycling program.

Table 6.6: The Relative Importance of Factors in Municipal Solid Waste Disposal

Factor	Abbreviation	Sum of Ranking	Average Ranking
Cost	FACRANKA	346	3.84
Environment	FACRANKB	126	1.40
Human health	FACRANKC	156	1.73
Aesthetic value	FACRANKD	363	4.03
Community spirit	FACRANKE	337	3.74

$W=.650$ Number of response=90

Questions 3 to 5 were directed towards the respondents' attitudes towards the benefits, major economic costs of, and barriers to, recycling. The Results were summarized in Table 6.7. Results indicate that the W for the benefits is

Table 6.7: The Ranking of the Benefits, Major Economic Costs of and Barriers to Recycling

Variable	Abbreviation	Mean	Standard Deviation	Coefficient of Variance	Sum of ranking
<u>Benefits of recycling (W=0.5522 Number of responses=65)</u>					
Produce revenue	BENERANKA	6.11	1.68	27.48	397
Minimize landfill space	BENERANKB	4.09	1.56	38.08	266
Conserve and reuse resource	BENERANKC	1.78	1.22	68.26	116
Reduce disposal costs	BENERANKD	4.77	2.01	42.06	310
Reduce pollution	BENERANKE	2.08	1.53	73.86	135
Support local charity	BENERANKF	6.78	1.48	21.88	441
Create jobs	BENERANKG	5.11	1.19	23.25	332
Stimulate community spirit	BENERANKH	5.74	1.87	32.64	373
<u>Major economic costs of recycling (W=0.4138 Number of responses=72)</u>					
Separation costs	COSRANKA	3.01	1.34	44.37	217
Collection costs	COSRANKB	4.32	1.24	28.77	311
Processing costs	COSRANKC	2.49	1.06	42.69	179
Transportation costs	COSRANKD	1.76	1.09	62.03	127
Administration costs	COSRANKE	3.78	1.12	29.54	272
<u>Barriers to recycling (W=0.3300 Number of responses=37)</u>					
Lack of time	BARRANKA	3.43	1.42	41.51	127
Lack of storage	BARRANKB	2.51	1.45	57.52	93
Inconvenience	BARRANKC	2.78	1.58	56.88	103
Difficulty of transporting materials	BARRANKD	3.30	1.65	49.97	122
Lack of direct financial incentives	BARRANKE	4.92	1.48	30.07	182
Lack of information	BARRANKF	4.92	1.66	33.67	182

significant enough to reject the null hypothesis. The perceived benefits, in the decreasing order of importance, are: to conserve and reuse resources, reduce pollution, minimize landfill space, reduce dump costs, create jobs, stimulate community spirit, produce revenue and support local charity. These findings are noteworthy, because, to the respondents the major benefits are resource conservation and pollution reduction, rather than the economic factors which provided the major motivation of the innovators at the start of the recycling program. This may reflect an attitude change since the initiation stage, perhaps due to generally increased levels of environmental awareness among the general public. Another possible explanation is that a contradiction may exist between expressed attitudes and actual behaviour.

The examination of major economic costs also found that W is significant and that the null hypothesis can be rejected. The main costs were found to be transportation, processing, separation, administration and promotion, and collection. This order of significance generally agrees with that established earlier using alternative methods.

Fifty-five per cent of the 104 respondents did not think there were any barriers to recycle. Data from the 37 respondents who ranked the barriers indicates that W is significant and the null hypothesis must be rejected. Ranking

shows that the barriers to recycling were relatively low on the scale of 1-6 with scores of 2.51-4.92. The most important barrier was lack of storage, followed in declining order of significance by inconvenience, lack of time, and difficulty of transportation. The least important barriers were considered to be lack of information and direct financial incentive. These results are consistent with those of The Environment Council of Alberta (1987) and Free (1986). However, they also found that inconvenience and trouble were the most common barriers identified by the public. Lack of information was not found to be a major barrier on Hornby Island. This is probably due to the very successful promotion of the program.

An effort was also made to measure respondents' dedication to the recycling program. Variables used were the time they were willing to spend on recycling (PUBPART) and their support of a higher tax (SUPTAX) for this purpose. It was found that the majority of the respondents (87 per cent) were willing to accept higher taxes to support successful recycling, but fewer than 4 per cent would devote more than two hours a week to recycling.

In summary, it was found that Hornby Islanders had a positive attitude towards recycling. This supportive attitude has increased willingness to participate in the recycling program, which, in turn, has contributed to its success.

6.2.5. Education and regulation

Effective education and regulation has also played an important role in making recycling a part of the islanders' everyday life. Education, through effective communication avenues, has not only increased public awareness of recycling, but has also generated peer pressure to participate in the program. These communication avenues were discussions with friends, the local newsletter and recycling brochures. Other activities such as the recycling fair and local meeting on recycling have also promoted the program. The drafting and enforcement of recycling regulations has, to some extent, made recycling mandatory on the island, which of course has helped to increase participation.

6.2.6. Reinvention

As discussed in Chapter 4, the components of an innovation are often modified, adapted and changed in the innovation process so that they are more suitable to the distinct (specific) organizational situation. The organization, therefore, often adopts a general concept, whose operational meaning gradually unfolds in the specification process of the adopting and implementing the new idea (Rogers and Adihikarya, 1979). Rogers (1983) studied a number of innovations and suggested that reinvention normally occurs at the implementation stage but only for certain innovations and specific adopters.

This study of the Hornby Island recycling program demonstrated that reinvention occurred during at least two stages of the innovation process. Typically, most recycling programs only handle newspaper, glass and tin-cans. However, when they were seeking a solution to their problem, Hornby Islanders adopted the idea of recycling but developed it into a comprehensive program, aimed at cutting down to the minimum by reuse, recycling, composting and burning the volume of municipal solid waste being landfilled. The 'free store' where reusable items are salvaged was good example of reinvention at this stage. During the hindsight evaluation stage, they again modified their program and introduced plastic, cardboard and rag material recycling. This was a further example of reinvention.

Reinvention of the innovation has greatly contributed to the success of the recycling program. This is because it gave the program flexibility which appears to have reduced mistakes and encouraged customization of recycling to make it more appropriate for local and changing island conditions.

In summary, it was found that the Hornby Island recycling program has successfully passed through the diffusion stages of problem recognition, the search for solutions, awareness of innovation, matching the innovation with a problem, trial, implementation, institutionalization and hindsight evaluation.

It has now entered a stage of improvement and demonstration. In this latter phase it is acting as a model which is being used to encourage recycling in other communities.

A number of factors have contributed to the success of the Hornby Island recycling program. These include a definite need for recycling, the establishment of the recycling committee, participation by key individuals, a cultural tradition and a decision-making environment which facilitated recycling, positive public attitudes towards recycling, effective education and regulation, and reinvention of the innovation. An understanding of these factors may provide some stimulus to other communities that wish to initiate or improve their own recycling programs.

The questionnaire responses also showed that lack of storage, inconvenience, and difficulties associated with transportation remain as barriers to public participation in recycling. These barriers need to be overcome in order to increase public involvement in the program.

Chapter 7

CONCLUSIONS AND IMPLICATIONS

The severity and urgency of municipal solid waste disposal problems has begun to stimulate recycling throughout North America. Most of this activity has been limited to large cities and little attention has been paid to the recycling activities of small communities. However, many such settlements are also experiencing serious problems with their solid waste. These problems are significantly different from those of urban centres, and therefore, call for special recycling programs. Small communities seeking to establish, or to improve, their recycling operations, need a model to follow. The program on Hornby Island appears to fill this role. As a consequence, a clear understanding of its evolution is highly significant.

7.1. CONCLUSIONS

This study had two major objectives; to evaluate how successful the Hornby Island recycling program has been, and to discover what factors have contributed to its development. These objectives were largely achieved. The preceding analysis demonstrated that Hornby Island has developed one of the most effective recycling programs in B. C. The program recycles perhaps the greatest number of materials, and achieves an estimated recycling rate of 85 per cent. The

program reclaims a total of 168 tonnes of recyclable materials with an estimated value of \$4,280-10,000 a year, providing a strong financial feasibility.

The examination of the development of the program showed that it has successfully passed through various stages of diffusion process, and has now entered a stage of exporting recycling to other communities. Although many factors may have contributed to the success of the program, the important factors were identified as a need for recycling, the establishment of the recycling committee, the active roles of the key individuals, the cultural history in favour of recycling, the homogeneity of the population, and positive attitudes towards recycling as well as effective education and regulation on the part of the island.

7.2. IMPLICATIONS

It appears that there are several ways that the results of the current study may have implications both for municipal solid waste management and for further research into the diffusion of innovation. However, it must be stressed that because of the unique geographical location of Hornby Island, the homogeneity of its inhabitants and their unusual cultural characteristics, including their positive attitudes towards recycling, not all results may be widely applicable. Those that are will most likely have relevance for small

communities, especially those on islands. Some conclusions, however, are more widely valid.

Most of the island communities of the Capital Regional District and some other islands on the west coast of British Columbia are as geographically isolated as Hornby Island. A few of them have similar cultural histories and population profiles. Many are also facing serious municipal solid waste disposal problems, comparable to those experienced by Hornby Island in 1976. For instance, the dump on Saltspring Island was recently closed by the B. C. Ministry of Environment, because of the potential pollution of nearby lakes (Paterson, 1990). A study undertaken by the Engineering Department of the Capital Regional District, found that only around 4 per cent of the municipal solid waste generated on the Gulf Islands was recycled, the rest was landfilled on, or off, the islands. A considerable volume was disposed of by illegal means, or at locations unapproved by the B. C. Ministry of Environment (McDonnell, 1986). There is no doubt that a lack of regulation and inadequate management has caused many pollution problems in these communities.

The results contained in this thesis may be of value to these island communities in several ways. Firstly, the Hornby Island recycling program may provide a baseline from which to assess their own municipal solid waste management practices,

and assist in identifying problems to establish recycling goals. Secondly, the Hornby Island recycling experience can be viewed as demonstration program. Its organization, facilities, operational procedures, administration and promotion may provide a stimulus which will encourage other communities to initiate and improve their own recycling program. For instance, the Cortes Island recycling program was established following the example of the Hornby Island recycling program. Thirdly, some of the improvements to traditional recycling, developed on Hornby Island may also have considerable relevance elsewhere. These improvements include the free store, adopting a comprehensive approach, establishing an agency, and effective education and reasonable regulations. The need to ensure that any recycling program remains flexible is also of critical significance.

A movement away from landfilling towards more recycling will help reduce municipal solid waste disposal problems. However, an effective recycling operation requires leadership and cooperation. Therefore, different levels of government should take the initiative in promoting recycling. The present research suggests that higher levels of government should build, as soon as possible, a transfer station, on a central part of Vancouver Island, to collect recycled materials from small operations, making it more economic to market them. Such governments should also establish

facilities for toxic and hazardous materials, making disposal more convenient and safer. Higher levels of government should also develop a database for recycling technologies, equipment, and most importantly, markets for recycled material. There should be also an increase in funding for research into municipal solid waste recycling and an increase in the financial assistance given to recycling programs. There is also the need to develop an effective education program, to increase public awareness and to promote public participation in recycling. An effort should also be needed to experiment with regulations designed to gain public support to supplement the education approach.

7.3. FUTURE RESEARCH

Although this study provides an in-depth analysis of the Hornby Island recycling program, the study results may be influenced to a certain degree by the limitations of this research. First, the research design of the questionnaire survey did not allow the establishment of non-response patterns, raising a question of how closely the sample represents the population. Second, there may be a question of how accurate the data from the questionnaire are when the respondents had the opportunity to falsify responses. Although considerable effort went into identifying variables that might be associated with the recycling behaviours, these

attempts were found to be ineffective. Two reasons may be postulated for this: the population may be too homogeneous to verify a variation and some respondents may be less than honest in completing the questionnaire. However, it may be fair to assume that the responses were accurate, since the topic of the study was not a contentious issue, the questions were unobstructive and the participation was absolutely voluntary and anonymous. Finally, because of the subject matter of this thesis dealt with a specific program, there was a need to rely heavily on local sources of information. Special emphasis in this regard was placed on obtaining information and opinions of the recycling committee members and the depot operators. The qualitative nature of the data did not purport to provide a definitive and quantitative assessment of the program.

Future research is needed in several areas. A more detailed study, for example, could attempt to quantify the amount of municipal solid waste generated, recycled, incinerated, and landfilled on Hornby Island to determine its recycling rate. Now that recycling operations are taking place in many communities in B. C. and other parts of the world, an accurately determined recycling rate can provide a base for comparative assessment. Equally important is detailed and well designed research to examine public attitudes towards recycling. The results of such a research

will improve public education programs.

This study focused on the diffusion of recycling as an innovation and generally appeared to provide further support for already well accepted innovation concepts. However, because of the relative low financial investment in recycling, the diffusion of recycling may not follow exactly the model developed by previous researchers. More study is required of the stage at which the concept of recycling is exported to other communities; and of the characteristics of the diffusion process.

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APPENDIX A

THE QUESTIONNAIRE SURVEY PACKAGE

A letter to the editor of The First Edition

A GRADUATE STUDENT LEARNING RECYCLING IDEAS FROM HORNBY

August 1, 1988.

Dear Editor:

I am a graduate student in the Department of Geography at the University of Victoria, and I am currently undertaking a research into the recycling program of Hornby Island as a part of my M.A. program. I send this letter to you hoping to get help from Hornby residents through your paper.

The disposal of municipal solid waste has, in the past two decades, become an urgent problem all over the world. As the volume of municipal solid waste being generated keeps increasing, landfill sites are filling up at a rate that is creating headlines and natural resources are being depleted at a pace which is concerning ecologists, economists and the public alike. Furthermore, municipal solid waste together with other wastes has caused serious environmental problems which are threatening wildlife and the survival of human beings.

As a consequence of this world crisis, certain innovations are being tested on a small scale. For example, Hornby island has adopted recycling and has initiated "free store" ideas. Hornby's approach may set a model to other communities.

Since recycling, as an alternative form of solid waste management, has evoked considerable controversy, my research project is designed to evaluate the Hornby Island recycling program and to examine public attitudes towards recycling. This research is being carried out by the Department of Geography, and is sponsored by the Sara Spencer Foundation. It may have very important implications in helping to improve solid waste management, therefore to tackle the world's solid waste problems.

Later, I will send, to all the Hornby permanent residents, a copy of questionnaire which will take about 20 minutes to complete. Although the participation of this survey is completely voluntary, your help in answering the questionnaire will contribute to the success of this research, and will be greatly appreciated.

If you have any questions regarding the research, please do not hesitate to contact me at 721-7345.

Thank you for your anticipated assistance!

Yours truly,

Jiandong Wang

UNIVERSITY
OF
VICTORIA



Please drop the completed questionnaire into the survey box in the Co-op store as soon as possible. Thank you.

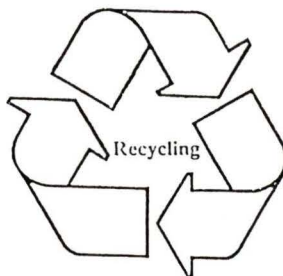
DEPARTMENT OF
GEOGRAPHY

P.O. BOX 1700
VICTORIA, B.C.
CANADA
V8W 2Y2

(604) 721-7345
TELEX 049-7222

THE RECYCLING PROGRAM ON HORNBY ISLAND

A Questionnaire Survey



Dear Sir/Madam:

I am a graduate student at the University of Victoria. I am currently undertaking research into the recycling program of Hornby Island as a part of my M.A. program.

The disposal of municipal solid waste has, in the past two decades, become an urgent problem all over the world. As a consequence of this world crisis, recycling has recently become a topic of considerable interest, but as an alternative form of solid waste management, it has evoked much controversy. This research is designed to evaluate the Hornby Island recycling program and to examine public attitudes towards recycling. It may have important implications in helping to improve solid waste management, thereby helping to tackle the world's solid waste problem.

This research is being carried out by the Department of Geography working together with the Hornby Island Recycling Committee, and is sponsored by the Sara Spencer Foundation. All the information solicited by this survey will be used for research purposes only and will be kept strictly confidential.

We estimate that it will take up to 20 minutes to complete the questionnaire. Participation of this survey is completely voluntary, but your help in answering the questionnaire will contribute to the success of this research and would be greatly appreciated.

Please drop the completed questionnaire into the survey box placed in the Co-op store as soon as possible.

If you have any questions regarding the research and the questionnaire, please do not hesitate to contact me at 721-7345.

Thank you very much for your anticipated assistance.

Yours sincerely,

A handwritten signature in cursive script that reads 'Jiandong Wang'.

Jiandong Wang

THE RECYCLING PROGRAM ON HORNBY ISLAND

A Questionnaire Survey



SECTION A

First of all, we would like to know how familiar you are with the Hornby Island recycling program.

1. Were you aware of the existence of the recycling program on Hornby Island before receiving this questionnaire? (Circle the number of your answer)

-1-. YES

-2-. NO

if your answer is yes, please continue with Question 2;
if your answer is no, please go to Section B.

2. From the following list of sources of information, please rank the TOP THREE IMPORTANT FACTORS from which you have heard the most about the Hornby Island recycling program (Rank the most important one to you 1, rank the least important one 3).

- | | |
|---------------------------------|-------|
| (a) Newspapers | _____ |
| (b) Magazines | _____ |
| (c) Radio | _____ |
| (d) T.V. | _____ |
| (e) Newsletters | _____ |
| (f) Discussion with friends | _____ |
| (g) Brochures | _____ |
| (h) Other, please specify _____ | _____ |

3. To the best of your knowledge, how long has the program been operating? (Circle the number of your answer)

-1-. Less than 1 year

-2-. 1-3 years

-3-. 4-6 years

-4-. 7-9 years

-5-. More than 9 years

4. Please indicate by Checking (✓) any of the following materials that you think are being recycled? (Check as many boxes as apply)

<input type="checkbox"/>
<input type="checkbox"/>
<input type="checkbox"/>
<input type="checkbox"/>
<input type="checkbox"/>

- 1-. Papers
- 2-. Glass bottles
- 3-. Tin cans
- 4-. Textiles
- 5-. Other, please specify_____

5. Please indicate how you think these materials are being separated from the rest of the waste? (Circle one number)

- 1-. By hand
- 2-. By machine
- 3-. Other, please specify_____

6. To the best of your knowledge, which of the following methods are used to collect the recyclable materials on Hornby Island ? (Circle the number of your answer)

- 1-. Unattended depots for drop off by residents
- 2-. Supervised depots for drop off by residents
- 3-. Curbside collection
- 4-. Other, please specify_____

7. Please indicate what happens to recycled materials on Hornby Island after they have been collected. (Circle more than one response if appropriate)

- 1-. Further processed and shipped off the Island to generate revenue?
- 2-. Trucked off the Island to another landfill?
- 3-. Landfilled on the Island ?
- 4-. Incinerated on the Island ?
- 5-. Composted on the Island ?
- 6-. Other, please specify_____

8. Were you aware that there is a "free store" at the recycling depot? (Circle the number of your answer)

- 1- YES
- 2- NO

if your answer is no, please go to Section B.

9. Please indicate the materials that you know the "free store" is handling? (Circle as many numbers as apply)

- 1-. Books and magazines
- 2-. Footwear
- 3-. Clothing
- 4-. Furniture
- 5-. Other, please specify_____

SECTION B

We would like to know something about your participation in the Hornby Island recycling program. Please answer all the questions by circling the number or numbers which best represents your choice.

1. Has your household participated in the recycling program? (Circle number)

-1-. YES -2-. NO

if your answer is yes, please complete this section.
if your answer is no, please go to Section C.

2. If yes, how long has your household been recycling approximately?

-1-. Less than 1 year
-2-. 1-3 years
-3-. 4-6 years
-4-. 7-9 years
-5-. More than 9 years

3. What articles has your household been recycling? (Circle all the appropriate numbers)

-1-. Newspapers
-2-. Other paper products
-3-. Glass bottles
-4-. Tin cans
-5-. Other, please specify _____

4. Where do you separate recyclable materials? (Circle all the appropriate numbers)

-1-. Partly at home
-2-. Entirely at home
-3-. Partly at the recycling depot
-4-. Entirely at the recycling depot

5. After you separate recyclable materials, what do you normally do with them ? (Circle all the appropriate numbers)

-1-. Take them to the recycling depot
-2-. Give them to a neighbor
-3-. Store them at home for pick-up
-4-. Other, please specify _____

6. How much time do you spend on recycling each week? (Circle one number)

-1-. Less than 1 hour.
-2-. 1-2 hours
-3-. 2-3 hours
-4-. More then 3 hours

7. Do you use the "free store" at the recycling depot?

-1-. YES -2-. NO

8. Do you consider recycling when you are purchasing new articles ?

-1-. YES -2-. NO

SECTION C

The following questions deal with your opinion on the Hornby Island recycling program, there are no right or wrong answers. Please answer all the questions by either circling the appropriate number or writing in the space provided.

1. How would you describe the Hornby Island recycling program?	^{very} successful	successful	average	unsuccessful	^{very} unsuccessful
	1	2	3	4	5

2. How would you rate the the following aspects of the recycling program?	^{very} successful	successful	average	unsuccessful	^{very} unsuccessful
(a) Produces revenue	1	2	3	4	5
(b) Conserves and reuses natural resources	1	2	3	4	5
(c) Reduces disposal costs	1	2	3	4	5
(d) Reduces pollution	1	2	3	4	5
(e) Reduces taxes	1	2	3	4	5
(f) Creates jobs	1	2	3	4	5

3. Please comment on the quality of the program in the following aspects.	very good	good	average	bad	very bad
(a) Administration	1	2	3	4	5
(b) Promotion	1	2	3	4	5

4. Which of the following aspects of the program would you say are inadequate? (Circle all the numbers that you feel are appropriate)

- 1- Air pollution control
- 2- Groundwater pollution control
- 3- The treatment of nonrecyclables
- 4- The treatment of plastics
- 5- Marketing of the recyclable
- 6- Other, please specify _____

5. How do you think solid waste management on Hornby Island, in general, can be improved?

SECTION D

Now we would like to know your attitude towards recycling as an alternative to other forms of municipal solid waste management. There are no right or wrong answers. Please answer all the questions by either circling the number or ranking your choices in order of importance.

1. In the list below, there are a number of alternatives for solid waste management. How good do you feel each of these methods is in the disposal of solid waste? (Circle the number of your answer)

	very good	good	average	bad	very bad
(a) Landfill	1	2	3	4	5
(b) Incineration	1	2	3	4	5
(c) Composting	1	2	3	4	5
(d) Recycling	1	2	3	4	5

2. What do you think are the most important factors that should be considered when dealing with municipal solid waste. (Rank the most important factor 1, rank the second important factor 2 and so on. The least important factor should be ranked 6)

- (a) Cost _____
- (b) Environment _____
- (c) Human health _____
- (d) Aesthetic value _____
- (e) Community spirit _____
- (f) Other, Please specify _____

3. What do you believe are the benefits of recycling? (Rank the most important benefit 1, rank the second important benefit 2 and so on. The least important benefit should be ranked 9)

- (a) Produces revenue _____
- (b) Minimizes landfill space _____
- (c) Conserves and reuses resources _____
- (d) Reduces dumping costs _____
- (e) Reduces pollution _____
- (f) Supports local charity _____
- (g) Creates jobs _____
- (h) Stimulates community spirit _____
- (i) Other, please specify _____

4. What do you think are the MAJOR ECONOMIC COSTS of recycling ? (Rank the the most costly factor 1, the second most costly factor 2 and so on. The least costly factor should be ranked 6)

- (a) Costs associated with separation _____
- (b) Collection costs _____
- (c) Processing costs _____
- (d) Transportation costs to market _____
- (e) Administration and promotion costs _____
- (f) Other, Please specify _____

5. How important are the following as BARRIERS to your participation in recycling? (Rank the biggest barriers 1, and the second biggest barrier 2 and so on. The smallest barrier should be ranked 7)

- (a) Lack of time _____
- (b) Lack of storage _____
- (c) Inconvenience _____
- (d) Difficulty of transporting materials _____
- (e) Lack of direct financial incentives _____
- (f) Lack of information _____
- (g) Other, please specify _____

6. Some people suggest that recycling programs need public participation. What do you feel your weekly level of involvement will be in the future? (Circle the number of your answer)

- 1- None
- 2- Less than 1 hour
- 3- 1-2 hours
- 4- 3-4 hours
- 5- 5-6 hours
- 6- More than 6 hours

7. Would you be willing to support recycling if it requires higher municipal taxation?

- 1- YES
- 2- NO

SECTION E

The following questions will provide important information about your household to ensure that this study includes a representative cross section of the Hornby Island population. Your response to this section will remain strictly confidential.

1. Are you (Circle one number)

- 1- A permanent resident of Hornby Island?
- 2- An owner of a vacation home?
- 3- A visitor to the Island?

2. In your household, is there anybody including yourself who plays a major leadership role in recycling? (Circle one number)

- 1- YES
- 2- NO

if your answer is no, please complete the rest of the questions with data about yourself.

3. If yes, how old is the person? (Circle one number)

- 1- under 15
- 2- 15-24
- 3- 25-34
- 4- 35-44
- 5- 45-54
- 6- 55 or over

4. What level of education has this person completed? (Circle one number)

- 1- Elementary school
- 2- High school
- 3- College
- 4- Graduate Studies

5. Is the person employed?

- 1- YES
- 2- NO

6. If the individual who promotes recycling is employed, describe the work the person does, please be as specific as possible.

7. Please indicate which of the following categories best represents your total household income.

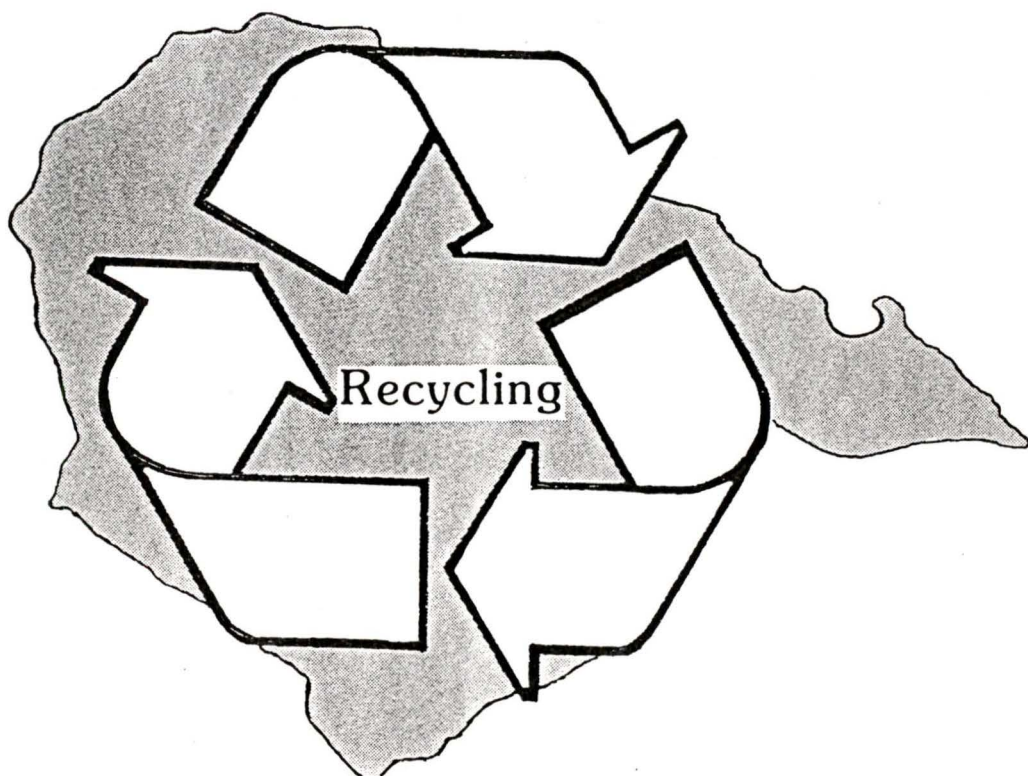
- 1- Under \$10,000
- 2- \$10,000-19,999
- 3- \$20,000-29,999
- 4- \$30,000-39,999
- 5- \$40,000-49,999
- 6- \$50,000-59,999
- 7- Over \$60,000

If you have any additional comments, please use this space. Use additional sheets if needed.

Thank you very much for your time and cooperation!

Please drop the completed questionnaire into the survey box in the Co-op store as soon as possible. Thank you.

HORNBY ISLAND RECYCLING PROGRAM SURVEY



Have you filled in the questionnaire yet?

If you have not please:

- Fill it in as soon possible
- Return the completed questionnaire to the drop-off box at the Co-op store

Thank you very much for your co-operation.

Jiandong Wang
Department of Geography
University of Victoria

APPENDIX B

HORNBY ISLAND RECYCLING BROCHURE

Hornby Recycles

all waste materials

WHY? ★ SAFE AND CLEAN ENVIRONMENT ★ GREATLY REDUCED TAXES ★ PRESERVATION OF NATURAL BEAUTY
 HORNBY'S RECYCLING SUCCESS REQUIRES EVERYONE'S CO-OPERATION

Please... do your part

- BRING YOUR HOUSEHOLD WASTES TO THE DEPOT IN THREE GROUPS FOR FURTHER SORTING...
- OUR SUPERVISORS WILL BE THERE TO ADVISE...

-OTHER SORTING GROUPS...

CANS AND GLASS...

- TIN CANS AND BOTTLE CAPS
- ALUMINUM CANS AND FOIL
- BATTERIES (DRY CELL)
- GLASS JARS AND BOTTLES
- LIGHT BULBS AND CERAMICS

BURNABLES...

- PAPERS AND CARDBOARD
- DISPOSABLE DIAPERS
- RAGS

PLASTICS... DUE TO ENVIRONMENTAL HAZARDS PLASTICS ARE NO LONGER INCINERATED AND MUST BE SEPARATED TO BE BALED FOR RECYCLING

FREE STORE...ANYTHING STILL USEABLE

- CLOTHES • SHOES
- BOOKS • TOYS • TOOLS
- APPLIANCES
- FURNITURE ETC.

SCRAP METALS...

- DERELICT VEHICLES (TOWING SERVICE...335-2672)
- MAJOR APPLIANCES
- BIKES AND PARTS
- ALL OTHER SCRAP (PLACE INSIDE DERELICT VEHICLES)

KITCHEN SCRAPS...IF BROUGHT TO THE DEPOT MUST BE INCINERATED TO AVOID VERMIN PROBLEMS - HERE ARE ALTERNATIVES...

- COMPOST OR BURY
- FEED PETS OR LIVESTOCK
- OFFER TO NEIGHBORS

CLAM AND OYSTER SHELLS...RETURN TO SEA

STUMPS, SLASH AND DEMOLITION MATERIAL WILL NOT BE ACCEPTED

OBTAIN BURNING PERMIT FROM POST OFFICE

CAUTION: WASTE HANDLING CAN BE DANGEROUS USE DEPOT AT YOUR OWN RISK AND SUPERVISE YOUR CHILDREN

DEPOT OPERATING HOURS

FROM MAY 18TH TO SEPT. 4TH
 OPEN DAILY 9 A.M. TO NOON

THROUGHOUT THE WINTER
 THUR. FRI. SAT. SUN. 9 A.M. TO NOON

APPENDIX C

THE FINANCIAL FEASIBILITY ANALYSIS

OF THE HORNBY ISLAND RECYCLING PROGRAM

(The calculation of the diversion credits)

**THE CALCULATION OF THE DIVERSION CREDITS OF
THE HORNBY ISLAND RECYCLING PROGRAM**

The Hornby Island Recycling program has successfully avoided the garbage, generated on the island, to be trucked to Pigeon Lake landfill. The money saved by the recycling program can be considered as diversion credits. An attempt was made to assess the amount of this saving by using the following methods:

1. Literature Review

- 1) Comox District Free Press (Friday, December 8, 1978)

"Estimates collected a year ago ranged from \$25,000 to \$60,000 a year from three different trucking companies, said Martin, and they will continue to rise".

- 2) Recycling Committee Report (1990)

"The attempt to avoid the trucking which was likely to be around \$85,000 a year, proved successful"

2. Theoretical Estimation

- 1) The quantity of garbage generated

The Capital Regional District used, in its study of Gulf Islands' municipal solid waste management, the following approximate relationship to estimate the quantity of municipal solid waste generated on the islands. The formula has also been found to work for other communities in Canada (Stanley

Associates Engineering Ltd. 1981).

$$Y = 0.048 X^{0.23}$$

where Y is the quantity of garbage in tonnes per capita per year, X is the contributing population.

Since Hornby Island's population varies from 1000 in the winter and to about 5,000 in the summer. The above formula was used to estimate the total amount of garbage generated by using both the summer and the winter population.

$$\text{Winter } Y = .048 \times 1000^{0.23} = 0.24 \text{ (per capita per year)}$$

$$\text{Summer } Y = .048 \times 5000^{0.23} = 0.34 \text{ (per capita per year)}$$

Assuming three summer months, the quantity of garbage generated on Hornby are calculated as the following:

$$\text{Winter (9 months)} \quad .24 \times 1000 \times 9 / 12 = 180 \text{ (tonnes)}$$

$$\text{Summer (3 months)} \quad .34 \times 5000 \times 3 / 12 = 425 \text{ (tonnes)}$$

TOTAL GARBAGE GENERATED ON HORNBY = 605 tonnes

Based on the information provided by the Capital Regional District: one typical plastic bag of garbage is 0.06 cubic metres and 1 cubic metre is 148 kilogram, the 605 tonnes of garbage is equivalent to about 680,000 bags of garbage.

2) Collection and disposal costs

According the study by the Capital Regional District, the following two islands are trucking their garbage off islands to landfill.

Pender island : garbage is collected by a private company and disposed of at Hartland landfill in Victoria at a \$1/bag

Mayne Island: garbage is collected by a private company and disposed of at Saltspring Island landfill at \$2/bag

Since Hornby Island has to truck the garbage to Pigeon Lake Landfill 65 kilometres (or 40 mile) away through two ferries, \$2/bag was assumed to be more realistic.

Therefore costs of collecting, trucking and disposing of at Pigeon Lake landfill was estimated to be at \$136,261 a year.

3. Estimation Based on some Information Gathered by the Interviews

- 1) Winter (9 months or 38 weeks)
 - based on about 5 tonnes (180/38)
or 11.2 Cubic Metres of compressed garbage a week
 - Collection 5 hr/week at \$65/hr = \$325/week
 - Transportation 1 trip/week
at \$500/trip = \$500/week
 - The winter costs = \$31,350
- 2) Summer (3 month or 13 weeks)
 - based on about 30 tonnes (425/13) or 69 Cubic Metres of compressed garbage a week
 - Collection 10hr/week = \$650/week
 - Transportation 4 trips
at \$500/trip = \$2000/week
 - The summer costs = \$34,450
- 3) Disposal cost (tax) in 1989 = \$26,100

The Total Costs Are Estimated At \$91,900 Plus the Costs of Administration and Equipments

4. Summary:

In the feasibility analysis, \$85,000/year was used as the diversion credits for 1978 and \$136,261 for 1989. The amounts for the other years were interpolated.

APPENDIX D

**PREFERRED PLASTIC POLICY: A SURVEY BY
THE HORNBY ISLAND RECYCLING COMMITTEE**

A SUMMARY OF THE RESPONSES TO THE SURVEY

	YES	NO	NOT SURE
1. Would you advise the depot to accumulate plastics until they can be safely disposed of ?	59	23	20
2. Do we just go on burning all the plastics ?	17	67	14
3. Do we bury it?	23	55	21
4. Refuse acceptance at the depot?	10	86	6
5. Bale it at extra cost and save it?	18	60	23
6. Phase out the use of throw-away bags and use only paper bags ?	85	13	4
7. Appeal to the co-op store and all stores to phase out practically all bags and customers develop their own bagging systems?	80	12	9
8. Is environmental damage related to over-use of plastic?	93	4	5
9. Can Hornby create a model for measures of limitation in use of plastics ?	83	8	10
10. Buy a \$5 basket to save the carry out bag?	43	52	6
11. Can Hornby show by action steps to reduce hazardous waste ?	90	8	4
12. Should we forget the whole subject and get along the way things are ?	6	95	1

Note: The number of response is 102, representing a 30 per cent response rate.

Source: Hornby Island Recycling Committee 1988.

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Author:


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September 28, 1990.