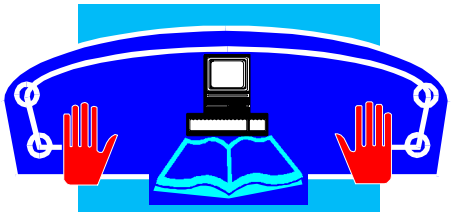

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Recycling Opportunities In The Northwest Territories

Type of Study: Analysis/review

Mining/oil/energy, Energy General

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RECYCLING OPPORTUNITIES IN THE NORTHWEST TERRITORIES

Final Report
February 1990

RECYCLING OPPORTUNITIES IN THE NORTHWEST TERRITORIES

Final Report
February 1990

Stanley

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March 15, 1990
File No.: 53-050-01-01

Mr. Craig d'Entremont
Industrial Technology Advisory
Science Institute of the Northwest Territories
P.O.Box 1617
Yellowknife, N.W.T.
X8A 2P2

Dear Mr. d'Entremont:

Reference Recycling Study

Enclosed is our final report: Recycling Opportunities in the Northwest Territories. This document incorporates comments and data received since submission of the draft report.

It was our endeavor to provide a comprehensive data base for the Northwest Territories, focusing on materials, quantities, technologies, methods and costs. Example program calculations are presented for the largest community, Yellowknife.

We trust the information compiled in this report will allow private parties, non-profit groups and government departments to property assess the viability of recycling as a materials recovery and waste management tool.

Sincerely,

STANLEY ASSOCIATES ENGINEERING LTD.

Ian B. MacLeod

Mr. Ian McLeod, P. Eng.
Manager, Yellowknife Office

Konrad M. Fichtner, Dipl. Ing.
Waste Management Specialist

KMF/jf

Enclosure

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1.0 INTRODUCTION

1.1 APPROACH

The intent of this report is to provide private citizens, businesses and all levels of government with a collection and presentation of data pertinent to the formulation and implementation of recycling programs, The following report will allow interested parties to assess the feasibility of recycling in the Northwest Territories with current waste quantities, and to determine under what conditions recycling would be economically feasible.

Examples of recycling operations in this report were chosen to provide a complete and comprehensive framework that can be used for the development of business plans. Technologies, costs, equipment, and manpower requirements can and should be modified on a case by case basis to reflect actual conditions, resources, scale, etc. The examples are also designed to act as check-lists to ensure that important planning components are not omitted.

The report encompasses all regions of the Northwest Territories as defined by the Bureau of Statistics, GNWT:

- Fort Smith Region
- Inuvik Region
- Kitikmeot Region
- Keewatin Region
- Baffin Region
- Yellowknife, being the capital city and most populous urban area, is assessed separately.

The report begins with a profile of the common recyclable materials from the domestic waste stream:

- Newspaper
  Cardboard
- Glass
- Household Metals
- Aluminum Cans
- Plastics

Origins and quantities of each of these materials, as well as their value and marketability are reviewed. The result is an up-to-date materials profile that can provide the data-base for future planning by recycling groups, business, or government departments

Typical recycling methods are presented. Technologies and costs applicable to Yellowknife are reviewed, as well as the transportation of materials to markets.

Recycling enhancement measures are the subject of the next section which provides an overview of various measures available to governments to enhance recycling and the possible impacts if these systems are implemented. Some of the more successful recycling programs outside of the NWT are reviewed and the possible impact of similar programs in the NWT are discussed.

The report concludes with an assessment of the gathered information and, with recommendations on how to approach recycling in the NWT it takes into account the unique combination of low population density, large geographical distribution of population, specialized industries, lack of economic transportation routes, pristine landscape, and a general willingness by the population to preserve natural resources and to keep their environment clean.

Financing for this project was jointly provided by the Government of the Northwest Territories, Renewable Resources, and by Pacific Metals ltd., Vancouver, B.C.

1.2 THE ROLE OF RECYCLING

There are four recognized waste management initiatives available to achieve waste minimization before ultimate disposal to the land: Reduce, Reuse, Recycle, Recover. These are described briefly below:

Reduce

Reduction of waste at source, before it is created, is the most desirable initiative. Wastes that are not produced do not require handling or disposal. Benefits include:

- no environmental costs (no emissions during manufacturing and no landfill space for disposal required)
- no collection and disposal costs
- preservation of natural resources

Re-Use

When it is not possible to reduce at source, then the re-use of a material or product that would otherwise become waste is desirable. Extending the life of an object by re-using it for a similar or other purpose than for which it was designed keeps it out of the waste stream for an extended period of time. Advantages are:

- less materials in the waste stream, thus extending landfill life
- lower collection and disposal costs
- less impact on the environment due to decreased manufacturing requirements
- preservation of natural resources

Recycle

Materials that have outlived their usefulness should, if possible, be recycled. Recycling could be defined as: The process by which secondary raw materials are created from waste materials. This can also include adding value to these materials through further processing. Recycling achieves maximum benefit from those materials that cannot be reduced or re-used and is considered today to be one of the most environmentally desirable forms of waste minimization. Advantages of recycling include:

- preservation of natural resources through displacement of virgin materials
- reduced dependency on landfills for waste disposal
- reduced waste collection and disposal costs
- creation of a secondary materials industry

Recycling is often initiated or supported by municipal or regional governments as a principle form of waste minimization. This report addresses recycling only,

Recover

Not all materials are recyclable (for example, due to contamination). Many of these waste materials, however, still contain resources that can be recovered. The most common recovery method is incineration for the recovery of the heating value in the waste materials. Other forms of recovery include such technologies as pyrolysis, where energy and elementary materials components are recovered.

1.3 APPENDIXES B & C PROVIDED BY SCIENCE INSTITUTE OF THE NORTHWEST TERRITORIES (SINT)

SINT has attached appendixes to this report showing practical applications of the information provided for specific, hypothetical alternatives (e.g. high cost, low cost). In addition, SINT provided lists of typical recycling equipment manufacturers, as well as some material market information.

2,0 RECYCLABLE MATERIALS PROFILE

2.1 GENERAL

This report focuses on common household materials, namely newsprint, cardboard, glass, metals, aluminum cans, mixed household plastics and beverage container plastics. There are some exceptions to this, namely where it was felt that quantities of specific materials from businesses would contribute to the recyclable material waste stream, These materials are fine papers from offices in Yellowknife and cardboard packaging from stores and smaller businesses. The estimates of mixed plastics also include plastics packaging discarded by wholesalers or retailers. Excluded are industrial metals, vehicles, white goods, oil, tires, industrial wastes, hazardous wastes, and organic wastes.

Material quantities are provided for all regions of the NWT The most accurate figures were available from the Yellowknife region and from the western NWT. Calculations based on proportion of population and best available data were made for the Baffin and Keewatin regions for some materials,.

The greatest quantities of materials theoretically recyclable are generated in the western NWT and would, if collected, be marketed in Western Canada. Consequently, transportation costs are estimated for bringing materials to these western markets. Values of materials are based on current prices paid in Alberta and British Columbia,

Wherever possible, actual quantities of materials brought into the NWT were obtained. When this was not achievable, quantities were calculated based on typical “northern” waste composition and consumption rates. A study into waste composition and quantities in arctic communities is currently being conducted by the GNWT Municipal and Community Affairs. Preliminary results have been made available and were utilized in quantity calculations.

A summary is provided at the end of Section 2 showing quantities of materials generated, quantities available for recycling, current market values of recyclable materials, and market trends.

2.2 PAPER

2.2.1 Definition and Sub-categories:

Officially, there are about 50 different grades of paper. In practise, only about 5 general waste paper categories are used, namely:

newsprint
containers/ boxboard
computer print-out
pulp substitutes/kraft papers
mixed (including magazines, catalogues, etc.)

According to "An Economics Study of the Recycling Industry in Alberta" carried out by Stanley Associates Engineering Ltd. in 1988 (SAEL Recycling Study). Newsprint and cardboard make up the majority of paper products consumed. Computer print-out and other office leger papers are of interest because of their high value. Kraft papers used primarily in product wrapping and packaging are being replaced by plastics. These products are also difficult to reclaim after use, Mixed paper has a low market value as well as very limited markets.

This study reviews the recycling of newsprint, cardboard and office paper.

2.2.2 ORIGINS AND QUANTITIES:

Origins of Waste Paper

Most newsprint originates in households, while cardboard comes from mainly commercial sources. Computer print-out and other fine papers originate in offices, government buildings, schools and institutions.

From the SAEL Recycling Study, it is known that cardboard makes up approximately 50% of total paper products landfilled, while newsprint makes up 20%. The balance is provided by "other" paper.

Quantities Available for Recycling

Quantities of newsprint were obtained from major printers in the NWT as well as from the airlines flying in daily newspapers from southern Canada, The distribution of newspapers outside of Yellowknife was also determined.

Quantities of cardboard are more difficult to determine and two methods of calculating cardboard quantities were used. Firstly, the per-capita use of cardboard in Alberta was projected for the NWT. Secondly, figures from the City of Yellowknife indicate that 10,550 tonnes of residential, commercial and industrial wastes were landfilled in 1989 and that 33% of this consisted of paper products. Since cardboard constitutes 50% of paper products landfilled, then Yellowknife produced 1,741 tonnes of waste cardboard in 1989. This figure is 12% higher than the Alberta per capita estimate, but will be used for this study, since most goods are imported into the NWT and packaged in cardboard boxes.

For all regions outside of Yellowknife, actual newsprint quantities were used as determined from the survey. Cardboard quantities used in other regions were estimated based on the per-capita consumption in Yellowknife. This appears realistic, since all products brought into the NWT must be packaged for shipment regardless of their destination.

While assuming that all newsprint and cardboard ultimately ends in the waste stream (and landfill), it is not possible, in practise, to recover all of this material, since some portions are permanently destroyed during use, or contaminated with other materials, thus rendering them non-recyclable. Actual recoverable quantities for the purpose of recycling vary significantly, depending on consumer habits, packaging standards, materials handling practises in businesses and industries, size of community and climate. Estimates range from 50% to 90% recoverability for newsprint and cardboard. Actual recovery rates will lie somewhere between these two extremes. For this study, an average value of 70% has been assumed for both newsprint and cardboard.

Table 2.2.1 provides estimates of total quantities consumed and quantities theoretically available for recycling in the various regions.

TABLE 2.2.1
ANNUAL QUANTITIES OF PAPER AVAILABLE FOR RECYCLING
(1989 ESTIMATE)

Region	Newsprint Consumed tonnes	Newsprint Theoretically Available for Recycling tonnes	Cardboard Consumed tonnes	Cardboard Theoretically Available for Recycling tonnes
Yellowknife	488	342	1,741	1,219
Fort Smith Region (excluding Yellowknife)	32	22	1,415	991
Inuvik Region	21	15	992	694
Kitikmeot Region	11	8	508	355
Keewatin Region	14	10	666	466
Baffin Region	29	20	1,331	932
TOTALS	**595**	**417**	**6,653**	**4,657**

Quantities of fine office papers can be calculated based on the number of office employees. Paperchase Recycling of Edmonton estimates that on average, they can collect about 2.5 kg of office paper per week per employee at participating offices. This represents up to 75'% of the waste paper generated,

There are 3,090 employees in business, finance, education and government located in Yellowknife, who thus generate about 515 tonnes of waste paper annually. Based on the assumption that 50% of the generated paper is high grade fine paper, then 258 tonnes of fine office paper are generated per year. If it is further assumed that three quarters of this is reclaimable, or from offices suitable for a waste paper collection program, then approximately 194 tonnes per year of fine paper, consisting of computer paper, white ledger and coloured ledger is theoretically available for recycling in Yellowknife.

Existing Recycling of Paper

There is no known recycling of newsprint or cardboard taking place in the NWT at this time.

In July of 1989, the GNWT Department of Government Services began a recycling program for office papers which is intended to service all GNWT offices in Yellowknife. Once the program is fully operational, about 1 full truck load (45,000 pounds) is expected monthly. This calculates to 245 tonnes per year; the proportion of fine papers in this quantity is not known but might be 50%.

2.2.3 VALUE OF MATERIALS AND MARKETS

Markets for used newsprint, cardboard and office papers exist in Alberta, British Columbia and eastern Canada. Most paper products recycled in Alberta and British Columbia are made into building products and insulation. Some are brokered to buyers outside the Country.

Markets for used newsprint are typically cyclical. Currently, prices are at a very low point of about $10 per tonne, FOB Edmonton, which is due to an over-supply as a result of a flat demand for building materials and the rapid introduction of newsprint collection programs by many municipalities in North America (in an effort to reduce waste quantities going to landfill). Used newsprint markets could not react as quickly as the material was being collected.

However, there are positive developments taking place. The lack of markets and the need for their creation has prompted several U.S. states to mandate minimum recycled fibre content in newspapers published in that state. Several Canadian provinces are considering a similar strategy. This has already led to an increased demand for recycled fibre, and new de-inking facilities are being planned for B.C. and Eastern Canada. When these de-inking facilities are on-line, then a strong demand, and subsequently higher price, for newsprint can be expected.

Office papers, consisting of computer print-out paper, white ledger, and coloured ledger, command prices of about $130, $100, and $80 respectively per tonne in Edmonton or Calgary. In certain cases, substantially higher prices have been achieved due to high market demand for a product.

2,3 METALS

2.3,1 DEFINITION AND SUB-CATEGORIES

Metals can be divided into two main sub-categories: Ferrous and nonferrous metals. Ferrous metals are the most common and generally are produced in the form of carbon steel and iron. Typical products made from ferrous metals are automobiles, appliances, household goods and packaging (tin cans).

Nonferrous metals are considered more costly to produce than ferrous metals, have special qualities and are often produced for more unique applications. Nonferrous metals can be subdivided into white metals (e.g. aluminum, silver, platinum) and red metals (e.g. copper, brass, gold). The major source of household nonferrous metals in the NWT is beverage containers, namely the aluminum can. Although smaller quantities of aluminum and other nonferrous metals are in the household waste stream, this study concentrates on the major component: the aluminum beverage container.

2.3.2 ORIGINS AND QUANTITIES

Origins of Scrap Metals

The scrap metals under consideration in this study are those within the domestic waste stream, excluding automobiles and white goods. About 90% of these metals are expected to be ferrous metals. The remaining household scrap metals will consist of mainly copper, brass, zinc and aluminum.

Aluminum beverage containers are assessed separately from the scrap in the domestic waste stream, since they represent an easily separable and identifiable resource, especially suitable for recycling,

Quantities of Scrap Metals

There are no known estimates of scrap metal quantities in the domestic waste stream of northern communities. In order to calculate quantities, percentages from the City of Edmonton's recent waste analysis are used. In Edmonton, 3% of residential waste consists of metals. Major projects excepted, there is very little manufacturing or fabricating being carried out in the NWT, thus, the residential rate from Edmonton would be applicable for most northern communities. On a per-capita basis, this results in a waste generation rate of 25 kg. per-capita per year for metals.

Scrap aluminum from beverage containers is easily quantifiable since quantities of containers are well known. Aluminum beverage containers are used for beer, brand name soft drinks and off-brand soft drinks. The NWT Liquor Commission provided annual quantities of beer sold in aluminum cans. Yellowknife distributors for soft drinks were able to provide estimates of annual cans being sold in Yellowknife as well as in the other regions of the NWT. Soft drink consumption in the Keewatin and Baffin Regions is not precisely defined but for estimating purposes, the per-capita consumption rate from the Inuvik Region was applied to these regions.

Table 2.3.1 provides a summary of scrap metal quantities generated by region.

TABLE 2.3. I
SUMMARY OF DOMESTIC SCRAP METALs PRODUCED BY REGION

Region	Mixed Metals (1) tonnes/year	Aluminum Cans tonnes/year
Yellowknife	338	123
Fort Smith Region excluding Yellowknife	296 (2)	56
Inuvik Region	193 (2)	37
Kitikmeot Region	100 (2)	19
Keewatin Region	131 (2)	19 (3)
Baffin Region	262 (2)	40 (3)
TOTALS	1,320	294

Notes:

(1) Residential metals, comprising approximately 88% ferrous and 12% non-ferrous metals.

(2) Based on per capita generation rate of 25 kg per year, actual generation rates in smaller communities may be lower.

(3) Based on per capita consumption identified for Inuvik Region of 193 soft drink cans per year, projected on the basis of population, plus beer can quantities as provided NWT Liquor Control Board. Soft drink consumption may be lower than assumed figures due to limited, seasonal access by water and no access by road to these Communities.

Recovery of consumer scrap metals from the waste stream is generally concluded on the basis of economics. A rule of thumb in the southern Provinces is that only about half of the metals in the waste stream are readily recoverable. Considering the distances and quantities involved, this will be even less in the NWT, however, the optimistic value of 50% recoverability will be used in calculations,

Aluminum beverage containers are not usually contaminated and up to 90% could theoretically be recyclable. Table 2.3.2 provides a summary of quantities of metals theoretically available for recycling in each of the regions of [he NWT

TABLE 2.3.2
SUMMARY OF DOMESTIC SCRAP METALs THEORETICALLY AVAILABLE FOR RECYCLING

Region	Mixed Metals (1) tonnes/year	Aluminum Cans tonnes/year
Yellowknife	169	111
Fort Smith Region excluding Yellowknife	148	50
Inuvik Region	97	33
Kitikmeot Region	50	17
Keewatin Region	66	17
Baffin Region	131	36
TOTALS	661	264

(1) Excludes industrial metals, vehicle bodies, 45 gal. drums.

Existing Recycling Activities

An aluminum can recovery program was started in June of 1989 by the Town of Inuvik, Recreation Department. Residents are asked to deposit aluminum cans in drop-off bins and businesses are requested to provide these cans for pick up by the town. Participation rates, to date, have been low, and the Town is considering an extensive education program to raise recovered quantities.

2.3.3 VALUE OF MATERIALS AND MARKETS

Constant markets exist for steel scrap in Alberta and Saskatchewan. Steel mills in Alberta and Saskatchewan rely primarily on scrap steel as a raw material for their furnaces, thus ensuring a constant demand for scrap.

Although these markets are relatively stable and secure, it is not economically attractive to recover all scrap metals from the waste stream, even in those areas where the mills are located. The steel mills must adapt their prices to world markets in order to remain competitive and this reflects on the price paid for scrap, which leaves only a small margin for the scrap metal dealer. If substantial transportation costs are involved, the recovery of steel for recycling may become economically unattractive.

There are various grades of scrap steel, all of which command different prices at the mill gate. Ferrous scrap from municipal recycling programs is currently (September 1989) worth about $35 per tonne F.O. B. Edmonton and $50 per tonne F.O. B. Calgary.

Aluminum is not recycled in western Canada, however, strong markets exist in eastern Canada and in the United States. Brokers have no difficulty selling scrap aluminum, provided it is acceptably clean and of sufficient density (usually baled) for economical transportation.

Generally, there are ample markets for both ferrous and non ferrous scrap metals. Economics dictate the degree of recycling activity. In the case of ferrous metals, profit margins are low, transportation costs are high and incentives may be required if collection or processing of post-consumer ferrous scrap is desired.

2.4 GLASS

2.4.1 DEFINITION AND SUB-CATEGORIES

Glass consumed by our society can be divided into the following categories:

- Containers (food, beverage, drugs, cosmetics, chemicals)
- Flat glass (window glass, motor vehicle windshields, mirrors and other laminats)
- Fibres for insulation
- Glassware (tableware, glasses)
- Miscellaneous products (jewellery, ashtrays)

According to estimates from the Container Council of Canada, approximately 70% of the volume of glass consumed is for glass containers and the remaining 30% is for flat glass, fibres, glassware and other miscellaneous glass products.

Glass containers are the most visible form of glass in the waste stream, since most glass containers are ultimately disposed. Other glass categories serve more permanent uses and are only discarded of in the case of accidental breakage or demolition. This study focuses on the reuse of glass containers (beer bottles) and on the recycling of glass from containers that are not reusable.

The majority of waste glass containers comprise three colours, clear, amber and green. Glass manufacturers utilizing waste glass (cullet) require that glass be separated into these three colours before it will be accepted as a raw material for the making of new glass.

2.4.2 ORIGINS AND QUANTITIES

In the SAEL Recycling Study, it was estimated that 55% of glass containers are for beverages, 33% are food jars and containers, and the balance is made up of medicine, cosmetic and others. The quantity of glass used for food containers is rapidly declining since many glass containers are now being replaced by plastics. The same is true for medicine and cosmetic containers. For this reason, this study will concentrate on glass beverage containers.

Glass beverage containers are used for:

- Beer
- Wines and Spirits
- Bottled Water
- Fruit Juices

Actual quantities of glass containers imported and distributed in the NWT were obtained from the NWT Liquor Commission and from soft drink, juice and water wholesale distributors, as well as major retailers, Beer bottles are produced primarily in one size and weights are calculated on the basis of 227.3 kg. per 1,000 bottles. Wine and spirit bottles come in a wide variety of sizes, and weights were calculated on the assumption that the average size is 750 ml. and that 1,000 bottles weigh 549 kg. 300 ml. and 500 ml. glass bottles for water and juices were assumed to have, on average, weights similar to beer bottles.

The most accurate figures of glass beverage containers used are available for Yellowknife. On the basis of weight, the distribution by source is as follows (for Yellowknife):

Wine and Spirit Bottles - 28%
Beer Bottles - 69%
Mineral Water Bottles -1 %
juice Bottles - 2%

According to beverage distributors, the use of glass mineral water bottles is being phased out in favour of P.E.T. plastics. The same trend is being expected for juice bottles. According to the Liquor Control Commission, the quantity of beer bottles sold has increased slightly over the past two years but the market share of beer bottles versus aluminum cans is dropping. There are currently no soft drinks being distributed in glass containers.

Table 2,4.1 provides the estimated quantities of glass beverage containers consumed as well as those estimated theoretically available for recycling. Figures are based on 90% of the consumed containers being available for re-use or recycling. Beer bottles currently being refilled are reflected in this table,

TABLE 2.4.1
ANNUAL QUANTITIES OF GLASS BEVERAGE CONTAINERS AVAILABLE FOR RECYCLING (1989)

Region	Containers Consumed tonnes/year	Containers Theoretically Available for Recycling tonnes/year	Reused & Recycled Containers tonnes/year	Remaining Containers Available for Recycling tonnes/year (2)
Yellowknife	1065	959	712	247
Fort Smith Region (excluding Yellowknife)	507	453	218	235
Inuvik Region	320	288	175	113
Kitikmeot Region	143	129	0 (1)	129
Keewatin Region	44	40	0 (1)	40
Baffin Region	132	119	0 (1)	119
TOTALS	2211	1988	1105	883

(1) Bottle recovery programs unknown.

(2) This quantity represents 90% of containers disposed in landfills.

Glass beer bottles are the only containers in the NWT that currently carry a deposit. A 10 cent deposit is placed on the bottles by Alberta brewers and is refunded when the bottles are returned to Alberta. This has prompted private recycling initiatives to collect bottles in Hay River, Yellowknife and Inuvik. A portion of the deposit is paid to the individual or business returning the bottles, the balance of the deposit received when the bottles are brought to Alberta is used to cover transportation, handling and overhead.

Two firms in Yellowknife collect beer bottles, and claim to recover a total of over 3 million bottles per year, mostly from liquor establishments. This represents 96% of all beer bottles sold in Yellowknife which appears high, and is probably due to the collection of beer bottles from communities surrounding Yellowknife as well. The firm collecting beer bottles in Hay River reported that about 958,000 bottles were collected in 1988. This number is higher than the quantity sold in Hay River, indicating that bottles are being recovered from other communities in the area, as well as Hay River. Actual recovery rates can thus only be determined for the Fort Smith Region as a whole (including Yellowknife). Based on total sales and returns for 1988, the recovery rate for beer bottles in the Fort Smith Region is 85% This is in the same range as what is being achieved in Alberta, which is near 88%.

Beer bottles in the Inuvik Region are collected by one firm in Inuvik, which estimates annual returns amount to 768,000 bottles. This represents a return rate of 78% excluding the Kitikmeot Region, or 54% including the Kitikmeot Region.

Small, undetermined quantities of beer bottles are occasionally collected by service groups or private individuals and taken to Alberta for recovery of deposits. These quantities are not expected to add significantly to the reuse rates already achieved.

used glass, provided it is free of contaminants and properly colour sorted, is suitable as cullet for the manufacturing of glass products. The closest glass facility to the NWT is the Consumers Glass plant near Vernon, B.C.

Prices paid for used glass by the Vernon facility are $77 per tonne F.O.B. their plant for clean, sorted glass. Colour sorted glass with labels, caps and neck rings not removed (typical grade from recycling programs) is worth $55 per tonne at the plant gate. Contaminated or unsorted glass will not be accepted. Transportation costs from Edmonton to the Vernon plant are approximately $35 per tonne.

Can-A-Sphere in Calgary also accepts waste glass, however, purchases are restricted to clean, clear glass only; no other glass will be accepted. Can-A-Sphere currently pays $4 I per tonne for this material.

Relatively stable markets for used glass exist, and if the high cost of sorting and transporting waste glass can be overcome, recycling of this material can be economically attractive.

2.5 PLASTICS

2.5.1 DEFINITION AND SUB-CATEGORIES

Plastics can be divided into two major groups, thermoplastics, which consist of polymers that can be repeatedly melted and remolded under heat, and Thermosetting resins, which, once solidifed, cannot be remelted and solidified.

Thermoses make up about 10'ZO of total plastics and are used mainly for non-disposable items. Therefore, thermosetting resins will not be considered in this study.

The major categories of thermoplastics are:

High Density Polyethylene (H. D. P. E.)
Low Density Polyethylene (L. D. P. E.)
Polyvinylchloride (P. V. C.)
Polystyrene (P. S.)
Polypropylene (P. P.)
Acrylonitrile Butadiene Styrene (A. B.S.)
Urethane
Polyethylene Terephthalate (P. E. T.)

2.5.2 ORIGINS AND QUANTITIES

There is no plastic manufacturing industry in the NWT and all plastics are brought into the Territories as finished products. Plastics in the waste stream consist primarily of post-consumer plastics.

The most common plastics in the waste stream are H. D. P. E., which is used in containers for oil, antifreeze, milk, detergent, etc., L. D.P. E, which is used for items such as shopping bags; P.V. C. and A. B.S. are used for building products and consumer goods; and Polystyrene, which is found in foam packaging, Plastic beverage containers are made of P.E.T.

Quantities of scrap plastics in the waste stream are calculated based on per-capita generation rates from the City of Edmonton, which were the most recent and accurate rates available at time of writing. The majority of scrap plastics are for packaging and since most products brought to the NWT require extensive packaging, this number may be conservative.

Calculated separately are P.E.T. plastics from beverage containers. The NWT Liquor Commission indicates that quantities of alcoholic beverages in plastic containers are negligible at this time, but are increasing. Most plastic containers are used for 2 litre soft drink bottles, and a small number can be found in 1 litre and 0.5 litre bottles. Estimates of P.E.T. plastic quantities are based on sales figures from soft drink distributors and major retailers in Yellowknife.

There is no known recycling of plastics in the NWT at this time. in plastics literature, a recovery of 25% to 50% of plastics in the waste stream is considered achievable. For this study, the conservative value of 25% has been assumed. For plastic soft drink bottles, however, the achievable recovery rate is closer to 90%.

Calculated quantities of plastics in the waste stream and quantities of theoretically recoverable plastics are presented in table 2.5.1.

TABLE 2.5.1
ANNUAL QUANTITIES OF PLASTICS IN THE WASTE STREAM AND ESTIMATED RECOVERABLE PORTION (1989)

Region	Mixed Plastics Disposed tonnes/year	Mixed Plastics Theoretically Available for Recycling tonnes/year	P.E.T. Disposed tonnes/year	P.E.T. Theoretically Available for Recycling tonnes/year
Yellowknife	1049	262	6	5
Fort Smith Region (excluding Yellowknife)	994	249	5	5
Inuvik Region	649	162	3	3
Kitikmeot Region	336	84	2	2
Keewatin Region	441	110	2	2
Baffin Region	880	220	4	4
TOTALS	4349	1087	22	21

2.5.3 **VALUE OF MATERIALS AND MARKETS**

There are basically two methods of recycling post-consumer plastics. The traditional method is to sort materials into their individual categories and then clean them for re-use as a resin. The second method is to accept mixed plastic and to re-form them into low grade construction materials. Both methods are being actively pursued by industry, governments and recycling groups.

The separation and subsequent cleaning of waste plastics, which enables their use as raw materials, is most desirable from a materials recovery point of view. Considerable research is being carried out in this area and large industries involved in plastics manufacturing have recognized the need to reclaim materials. Firms such as Dow Chemical, Domtar, and G.E. Plastics are expending considerable effort on research into facilities for the identification, separation and the cleaning of waste plastics. Efforts are also focused on the design for recyclability (uni-plastic containers) and markings for easier identification of resins. Impressive projects are being launched however; they are still in the planning or conceptual stage.

The method of reprocessing waste plastics in a mixed form originated in Europe and is being introduced into North America. The technologies utilize soft resins, which make up about 3/4 of the waste plastics, to soften and capsulate those plastics and foreign materials that have a higher melting point. The result is a plastic construction material that is often called plastic lumber. It is marketed as a substitute for wood wherever a rot, splinter and bacteria proof material is required that is also resistent to water and chemicals.

Markets exist for post-consumer plastics provided they are separated, clean and properly baled. Most of these markets are in the north eastern United States and prices are in the $100 per tonne range F.O.B. plant. There are two smaller companies in Alberta considering the recycling of soft plastics (L.P.D.E.), and one of these firms is accepting small quantities from the Edmonton Recycling Society. Capacity currently does not exist for accepting additional quantities. An Edmonton firm that was established to recycle PET from softdrink bottles went into receivership in 1989.

Markets for mixed post-consumer plastic wastes are almost nonexistent. Dow/Domtar is setting up a venture to recycle post-consumer plastics and is collecting and stockpiling material from the Maritimes to as far west as Saskatchewan. Prices paid for plastics, (hard plastics only are accepted), are about $66 per tonne,

The Edmonton Recycling Society is considering the purchase of the necessary machinery to fabricate profiles from mixed plastic wastes. Should the plans proceed, and assuming markets for the plastic lumber are found, then this operation would provide substantial markets for mixed plastics and would have the capacity to handle any plastics coming from the NWT.

Generally, it has been shown that wherever waste plastic materials are sorted and cleaned, a market for them can be found. An example for this is the P.E.T. from soft drink bottles. In Alberta, all P.E.T. from soft drink containers is collected through the beverage container program and until recently, was sold to Applied Polymer Products in Edmonton for recycling. This firm is no longer in business but plastics brokers have indicated that markets for P.E.T. in the U.S. exist, although transportation costs make the recovery, processing and shipment of materials marginal at best. The separation of other plastic resins (besides PET) is extremely difficult without sophisticated, expensive equipment. In the near future, manufacturers may mark plastic products, which would greatly simplify manual sorting of plastic wastes.

An alternative use for scrap plastics is as a source of fuel. This is a logical utilization of this resource if it would otherwise have to be landfilled. Plastics are made from hydrocarbons, and the heating value in scrap plastics is comparable to coal, Modern combustion technology and emissions cleaning equipment can ensure that off-gases from the burning of plastics are acceptable, albeit at a very high cost. The feasibility of using scrap plastics as an alternate fuel could be further researched to determine feasibility in Northern communities. However, incineration for heat recovery is the fourth R of waste management and should only be applied as a last resort when the opportunities through reduction, reuse and recycling have been exhausted.

2.6 MATERIALS PROFILE SUMMARY

2.6.1 QUANTITIES AVAILABLE FOR RECYCLING

In the previous sections, estimates were made of quantities of materials consumed and deposited in the waste stream, and the portion of these materials that is theoretically available for recycling. A summary and overview of materials consumed/disposed in the NWT is presented in Table 2.6.1 by region and material. The same breakdown is provided in Table 2.6.2, which shows the quantities of materials theoretically available for recycling. In this table, those quantities already being recycled (or reused) have been subtracted.

Not shown in these tables are the potential quantities of fine papers available from offices in Yellowknife. Approximately 515 tonnes of office paper products are being disposed annually in Yellowknife, of which about 194 tonnes per year are considered recoverable fine papers. The Department of Government Services of the GNWT is in the process of implementing its own paper recycling program. It is anticipated that approximately 250 tonnes per year of office papers will be collected from the 2,000 employees in the GNWT offices, and of this total about 125 tonnes will be fine office paper.

It is interesting to note that based on quantities of materials theoretically available for recycling, cardboard has by far the greatest potential, followed by mixed plastic, mixed metals and glass containers. Newsprint is not as significant a portion in the waste stream as it is in southern regions, since newspapers are not printed daily and the weight is also considerably less than in larger metropolitan areas.

The quantity of aluminum cans available is considerable, indicating that aluminum appears to be the container of preference for beverages in the NWT P.E.T. Plastics have made some inroads, but are not as widespread as is common in southern communities. Plastics are however, replacing glass for bottled water, fruit juices and to a small degree, liquors.

When reviewing the value of materials, as shown on Table 2.6.3, the picture changes dramatically. Aluminum has a very high market value, followed by fine paper, glass, plastics and cardboard.

TABLE 2.6. I
SUMMARY OF MATERIALS CONSUMED/DISPOSED IN NWT (1989 ESTIMATE)

Region	Material Category, tonnes per year						
	Newsprint	Cardboard	Mixed Metals	Aluminum Cans	Glass Containers (1)	Mixed Plastics	P.E.T. Plastics
Yellowknife	488	1741	338	123	1065	1049	6
Fort Smith (excluding Yellowknife)	32	1415	296	56	507	994	5
Inuvik Region	21	992	193	37	320	649	3
Kitikmeot Region	11	508	100	19	143	336	2
Keewatin Region	14	666	131	19	44	441	2
Baffin Region	29	1331	262	40	132	880	1
TOTALS	595	6653	1320	294	2211	4349	22

(1) For all materials except glass beverage containers, material consumed approximates material disposed to landfill. Due to the recovery of beer bottles in Yellowknife, Hay River and Inuvik, the above figures for glass represent number of containers sold/consumed only.

TABLE 2.6.2

SUMMARY OF MATERIALS AVAILABLE AND THEORETICALLY Recyclable (1989 ESTIMATES)

	Material Category, Tonnes Per Year '						
Region	Newsprint	Cardboard	Mixed Metals	Aluminum Cans	Class[(1)] Containers	Mixed Plastics	P.E.T. Plastics
Yellowknife	342	1219	169	111	247	262	5
Fort Smith (excluding Yellowknife)	22	991	148	50	235	249	5
Inuvik Region	15	694	97	33	113	162	3
Kitikmeot Region	8	355	50	17	129	84	2
Keewat in Region	10	466	66	17	40	110	2
Baffin Region	20	932	131	36	119	220	4
TOTALS	417	4657	661	264	883	1087	21

(1) Reused and recycled quantities have been subtracted.

2.6.2 CURRENT MARKET VALUES

Economics of recycling is influenced by the availability of markets, the distance to these markets, and the market value of the recovered materials. Typical values of recyclable materials, status September 1989, are presented in Table 2.6.3.

TABLE 2.6.3

MARKET VALUE OF RECYCLABLE MATERIALS

(SEPTEMBER 1989)

Material Category	Price $ Per Tonne (1)	F.O.B.
Newspaper	10	Edmonton, Alberta
Cardboard	45	Edmonton, Alberta
Office Paper (4)	80-130	Edmonton, Calgary
Glass	77.55 (2)	Vernon, B.C.
Fe-Metals	35 (3)	Edmonton, Alberta
Aluminum	1000	Calgary, Vancouver
Mixed Plastics	66	Ontario (5)
PET Plastics	110	Calgary

(1) September 1989 average prices.

(2) Color sorted glass only. This price is typical for glass from recycling programs that contain caps and neck rings. Sorted cullet consisting only of glass and labels has a market value of $77 per tonne.

(3) Price for low grade ferrous metals, as typically received from recycling programs.

(4) Office paper must be well sorted into individual categories and uncontaminated,

(5) Location not yet determined

Generally, recycled goods are resource materials and are marketed in the same way as natural materials. Prices are determined by world, commodity markets and the market value of recycled materials is subject to the same fluctuations as other raw materials, Historical development of prices for several typical recycled materials is presented in Figure 2.6,1.

The prices of many recycled materials fluctuate considerably which strongly impacts the viability and profitability of recycling operations and complicates planning of future recycling programs.

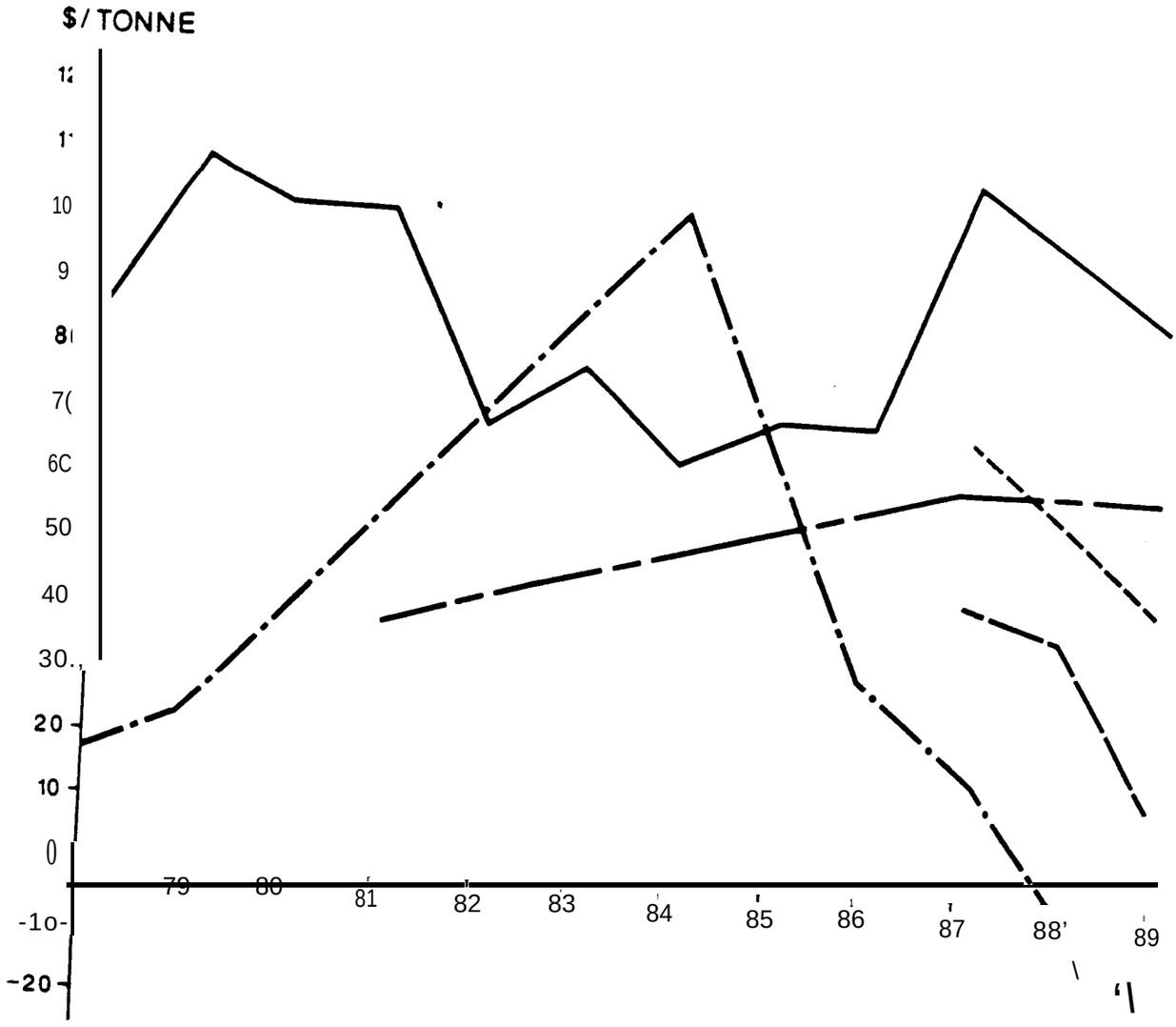

Figure 2.6.1

PRICE HISTORY OF COMMONLY RECYCLED MATERIALS

2.6.3 BARRIERS AND TRENDS

Key barriers to recycling in the NWT apply to most materials under consideration and are common to communities throughout western Canada. In many cases, the remoteness of northern communities, and the available transportation modes tend to make recycling even more difficult.

By world market standards, the volumes of materials from the NWT are relatively small. Small quantities provide little negotiating power when materials are being sold to southern or overseas markets. Long transportation distances to recycling centres raise costs substantially and play a key role in the economics of recycling.

Small volumes of materials also affect firms wishing to reprocess materials locally. In many cases, expensive hardware is required and economies of scale are not available to justify this equipment. Furthermore, markets are small, which reduces the prospect of selling large quantities of recycled goods locally.

Markets and market fluctuations can cause problems. Stable markets and/or financial assistance is needed for recycling operators to survive.

The recycling industry is dynamic and currently in a state of rapid change and growth. The following trends have been observed for the materials under consideration.

Consumption of paper in Canada is growing and it is anticipated that demand for waste paper products will increase in the long term, The value of fine office papers is consistently high, and the value of cardboard has stabilized and is expected to grow. Newsprint prices are reported to have bottomed out and are expected to remain flat in the short term; however, the creation through (legislation) of new markets for recycled fibre in the U.S. is expected to dramatically improve the prospects for used newsprint,

Glass containers are being increasingly replaced by aluminum and plastics. This trend has been ongoing for some time and is expected to continue. Consumer preference, such as for bottled beer, may slow the transition to other materials but is not expected to stop it. Soft drinks for example, are no longer available in glass containers. Glass jars are generally perceived to be a valuable product and considerable re-use of these containers takes place.

Metal recycling is well established in western Canada and based on free enterprise. Prices are dictated by supply and demand. As prices for recycled metals increase, so do the recycling rates.

Plastics have become a high profile material due to their increasing use in consumer products and packaging and their visibility as litter. Properly disposed in a landfill, plastics do not constitute an environmental threat, since they are relatively beneign. Nevertheless, public pressure is mounting on Government Officials to undertake measures to reduce plastics in the waste stream. It can be expected that markets will develop for mixed plastics within the next decade as major recycling programs in the Provinces and U.S. provide abundant supplies of these materials and pressures mount to recycle them.

There are a number of trends applicable to recycling in North America as a whole. Through the media, the consumer is being made aware of waste quantities and perceived waste disposal problems. Citizens are putting pressure on elected officials to implement waste reduction measures. They are asking for the planning and implementation of recycling programs, requesting governments to assist in creating new markets for materials and are beginning to exercise their power with selective buying of consumer products and packaging. In the long term, this will create or strengthen the infrastructure and markets for the recycling of most common secondary materials.

The general public in North America is beginning to accept the 4 R's (especially recycling) as a necessity, both from a waste management and from an environmental point of view, along with associated additional costs when compared to landfill disposal.

3.0 RECYCLING TECHNOLOGY AND COSTS

3.1 GENERAL

A discussion of recycling technologies requires a precise definition of what is to be recycled, the quantities involved and the distance of the operation from markets. There is no such thing as a 'generic" recycling system. Each operation must be tailored to the specific conditions and needs of the community or region being serviced. This is especially true in the NWT with its geographic spread, limited transportation modes, and varying economic conditions.

In this section, two recycling options are presented for the City of Yellowknife. The Yellowknife region was selected for study purposes since it has the greatest concentration of population and consequently, the greatest quantity of potentially recyclable materials in its waste stream, Furthermore, private recycling operations have already begun in the City.

The options presented below are based on a high-tech, high-cost approach to recycling for private industry, and thus represent the "worst case" scenario. However, the framework created by this scenario is believed to be the most comprehensive and most suitable for presentation, that can stand as a model for other scenarios. Since it is not feasible to develop programs for the numerous variations and possibilities available to firms or groups interested in recycling, it is intended that the framework presented in this report be used to develop and custom tailor recycling programs to suit individual regions, objectives, and resources. For example, costs can be cut (and substituted in the framework) in numerous ways:

- involvement of non-profit groups and volunteer labour
- use of manual, low-tech equipment
- purchase of used equipment
- donations of facilities or equipment
- special transportation agreements/rates
- direct government grants
- local subsidies
- internal subsidies (e.g., the use of a high profit material, such as aluminum, to help pay for recycling of paper)
- legislative protection, which could ensure that the recycling group has access to all high value materials.

The following recycling options are reviewed:

- Drop off recycling depot
- Curbside collection

Approximate option components and costs, as well as quantities of recycled materials are presented. Cost figures are based on estimates received from equipment suppliers, transportation companies, and on experience with recycling operations in other regions and communities.

3.2 TRANSPORTATION

One of the principal costs common to any economic activity dealing with the south is transportation. The delivery of goods to southern markets directly impacts the economics and feasibility of recycling operations in the NWT

The most economical method of transporting goods to Edmonton, Alberta is by truck. Several trucklines deliver goods to Yellowknife on a regular basis and must return to Edmonton with empty vehicles. Special "back haul" rates are provided by trucking companies to reduce the costs of empty return trips. Current beer bottle recycling is carried out by back haul.

Barging goods to Hay River and then transporting them by rail to Edmonton was assessed and deemed uneconomical in a previous recycling study, Rail rates are considerably higher than trucking costs and do not include the additional handling and transferring of materials at both ends.

A common transportation container used by the trucking industry is the pup-trailer. These have a loading size of approximately 8' wide by 8' high by 27' long and can carry up to 25,000 lbs. Back haul rates quoted by major trucking companies are as follows

- Full pup-trailer -$500-$800
- Full load (45,000 lbs) - starting at $1,000

These rates are from Yellowknife to Edmonton and exclude loading or unloading, but usually include a 24 hr. loading or unloading allowance at each end. Trucking companies are generally open to negotiating rates, especially if consistent quantities are shipped on a regular basis. Also, it may, in some instances, be possible to ship partial loads or loads based on volume; these must also be negotiated individually.

3.3 DROP OFF RECYCLING

Drop off recycling refers to the establishment of one central or several decentralized 'depots located in the City at which residents can drop off collected quantities of specific recyclable materials. The common materials collected by most recycling programs in southern Canada are paper, cardboard, glass and metals. Plastics may join this list in the future.

There are two types of drop off depots under consideration, the unmanned and the manned facility. Unmanned facilities generally provide bins for the materials being collected, which are open to the public. Materials from these bins are collected periodically, sorted in a warehouse, and consolidated and prepared for shipment to markets.

Manned drop off recycling is similar to unmanned, but it adds several convenience features due to the fact that it is manned. Manned drop off depots have better quality control and product purity, since contaminated materials can be rejected or discarded at source before they contaminate an entire batch. There is also a perceived higher level of convenience by the public, since the operator would be able to assist and direct individuals bringing materials to the depot. This personal service can increase participation rates.

Drop off recycling centres are relatively low cost options when compared to curbside pick up programs. Their advantages are low initial costs and their flexibility to recycle additional materials if that becomes profitable. Disadvantages of drop off systems include the necessity for the public to transport materials to the depot and the limitation to residential wastes (contributions from commercial establishments are difficult or unlikely), and an extensive education program is required to motivate residents to separate and bring their recyclable materials.

Recoverable Quantities **with a Drop Off Depot**

As **a rule** of thumb, a successful drop off depot can recycle about half of what **a** curbside collection program can obtain. This is an optimistic projection based on willingness by citizens to actively participate and on an extensive education program informing the public what, how, and where to recycle,

Taking the recovery rates from Edmonton's curbside recycling program as a basis, the projected recovery of materials with a manned drop off depot is presented below in Table 3.3.1.

TABLE 3.3.1

PROJECTED ANNUAL QUANTITIES OF MATERIALS RECYCLABLE WITH A MANNED DROP OFF DEPOT

Materials	Quantity Theoretically Recoverable in Waste Stream tonnes	Recovery %	Recovered tonnes	Market Value of Recovered Materials September 1989 F.O.B. Yellowknife $ (1)
Newsprint	**342**	**40**	**137**	**<-7,809>**
Cardboard	**1,219**	**12**	**146**	**<-3,212>**
Glass	**247**	30	74	<-3,478>
Metals	**169**	**6**	10	<-320>
Aluminum Cans (2)	111	**30** (3)	33	30,789 (4)
TOTALS			**400**	15,970

Notes

(1) **Market value F.O.B. Yellowknife is calculated based on average shipping costs to Edmonton of $600 for a** 20,000 lb. load, or S67 **per tonne.**

(2) **Aluminum cans must be densified into bisquettes**

(3) **Same recovery rate for aluminum cans as for non deposit glass bottles (excluding re-usable beer) is assumed. Some participation by commercial establishments is required. The best achievable recovery rates for aluminum cans (without deposits, but with 2 cents per can buy-back) is about 50% in other jurisdictions.**

(4) **Assumes** aluminum price, **F.O.B. Edmonton is $1,000 per tonne for cans in desified form.**

The figures presented in the above table are theoretical and are based on the assumption that markets for the materials are available.

A single manned depot has been chosen for Yellowknife as an example for this report, which is expected to provide better service and recycling rates than an unmanned depot without incurring the high costs of a curbside pick up program.

It is evident that only one material is economically recyclable at this time, namely the aluminum can. Aluminum cans make up only about 11% (by weight) of the recovered wastes but due to their high market value, could help to pay for the recycling of other materials in an overall operation.

Drop Off Depot Equipment and Operating Costs

The following list of equipment and costs are compiled for a depot collecting all of the materials listed in Table 3.3.1. If fewer materials are to be collected, then equipment requirements will be reduced as a consequence (for example: if there is no recycling of paper and cardboard, there will be no requirement for a baler).

The building for a recycling centre should have about 1,500 sq. ft. of enclosed and heatable space. Of that, about 150 sq. ft. would be required for an office. The building must be accessible by the public with their vehicles and must also possess a ramp for the loading of trailers, Preferably, the building would be acquired on a lease basis.

Mechanical systems required would include a heater for the warehouse space and a separate heater for the office. Electrical systems would comprise inside lighting, outside lighting and 120/240 volt power for equipment.

The following major equipment would be required for full scale commercial operation:

- forklift
- aluminum can densifier
- aluminum/steel separator, complete with conveyor
- glass crusher
- baler for newspaper and cardboard, (future plastics)
- scale
- material receiving hoppers
- bulk pallet containers and pallets
- miscellaneous smaller handling and packing equipment

Office equipment would consist of furniture, typewriter and calculator. Estimated costs for the various pieces of equipment are presented below. These costs should not be considered final but merely representative of what is available on the marketplace today. New and improved products are constantly being offered and prices tend to fluctuate.

Estimates of capital and operating costs are summarized in Table 3.3.2.

TABLE 3.3.2

ESTIMATED COSTS FOR A DROP-OFF DEPOT

capital Costs Item	Average Price $
Forklift	30,000
Can densifier, with conveyor and fe-metal separator	20,000
600 lb./hr. baler, manual load, manual tie	40,000 *
Scale	5,000
8 Self tipping bins@ 3,oOO	24,000
Palletizing equipment and miscelleanous materials	10,000
Sub Total	129,000
Contingency 15%	19,350
TOTAL CAPITAL COSTS	**148,350**

Amortized over 15 years @ 12% = $21,778 per year

* Note **These represent maximum costs; smaller, less expensive balers are available.**

Operating Costs	$ Annually
Wages, one operator full-time, with benefits	40,000
Part-time secretarial and bookkeeping	10,OOO
Operating and maintenance costs (5% of capital costs)	5,000
Building lease @ $12/sq. ft., including utilities	18,000
Sub Total	73,000
Contingency 15%	10,950
TOTAL OPERATING COSTS	**83,950**

Summaw of Costs	$ Annually
Capital Recovery Costs	21,778
Operating Costs	83,950
TOTAL ANNUAL COSTS	$105,728

Note:

These costs do not include an education program, which is fundamental to the success of any recycling operation. Minimum annual costs for education programs and advertising can be expected to be in the $10,000 to $30,000 range.

From the above tables, it is evident that if all of the listed materials are to be recycled, some form of subsidy will be required. If only aluminum cans are recycled, the operation could be very lucrative, since profits would not be used to subsidize other materials and there would be fewer requirements for equipment and labour. Ideally, a combination of aluminum cans and one or two other materials could be recycled without the need for additional subsidies. The selection of materials will depend on the perceived urgency in the community to recycle these materials and on the resources of the recycling operator. It may be necessary to start with aluminum cans only, and when sufficient profits have built up, to expand to glass, or some other material. Initial start-up assistance, either monitary or in-kind, may be required from local or regional governments.

3.4 CURBSIDE PICK UP RECYCLING

Curbside pick up recycling is often used by large municipalities as a high profile (and costly) method of reducing the quantity of wastes going to the landfill. This method of recycling has become popular due to the achievable high recovery rates of residential materials and the shortage and high cost of landfill space in many eastern Canadian and north eastern U.S. municipalities. The largest curbside recycling program in Western Canada is currently being implemented in Edmonton, where close to 140,000 households have access to this recycling method.

Curbside pick up programs are often called “blue box” programs because of the plastic blue boxes used to collect materials. There are three variations that can be used in operating curbside pickup programs:

- Unsorted; all materials designated as recyclable are placed in a single bin, which is picked up and brought to a recycling centre.

- Unsorted but separated during collection into compartmentalized collection vehicles; unsorted materials in the collection bin are sorted during the collection process into the various compartments of the collection vehicle at the time of pick up.

- Separated into separate bins and collected with a compartmentalized vehicle; homeowners are supplied with stackable bins designated for various types of recyclable materials. Collection is simplified since materials are already sorted and direct loading of a compartmentalized vehicle can take place.

The collection of unsorted materials with separation into a compartmentalized vehicle (second alternative) appears to be the most efficient system overall since it requires less sophisticated sorting equipment at the central plant and avoids the cost of multiple bins at curbside. This type of system would also be considered for the City of Yellowknife.

Curbside programs only address the quantities of recyclable in the residential waste stream. Multiple family dwellings and commercial/industrial establishments must be serviced by a separate type of recycling system. In Yellowknife, it is estimated that approximately 2,850 households could be serviced by a curbside recycling program.

The common materials collected are newspaper, glass and metals. Some cities are also collecting cardboard and plastics, although a market for plastics does not yet exist. The City of Edmonton, which recently introduced plastics collection, is baling and storing the material until markets are available.

Curbside recycling can be handled by city crews but, in most cases, the total recycling program is contracted out to" private companies or nonprofit organizations.

Curbside recycling is, for residences, by far the most convenient method of recycling, which explains the high participation rates ranging from 70% to 90%. Other advantages of the system are good quality control of the collected materials and the possible use of the same infrastructure to expand the program to other materials. The program has a high perceived community benefit.

There are however, drawbacks associated with curbside recycling. Capital and operating costs are very high and thus curbside programs usually require substantial subsidies from the municipalities being serviced. A curbside recycling program does not adapt well to market fluctuations, Once set up, it is difficult to stop and restart the flow of materials in accordance with market conditions. Curbside recycling is also an inflexible strategy, once committed it is costly to change or cancel the program.

Quantities of materials recoverable in Yellowknife through a curbside collection program are presented in Table 3.4,I. Recovery percentages are based on actually achieved values in Edmonton for newsprint, glass and metals. (Information provided by City of Edmonton, Environmental Services).

TABLE 3.4. I
PROJECTED ANNUAL QUANTITIES OF MATERIALS RECYCLABLE
wITH A CURBSIDE PICK UP PROGRAM

Materials	Quantity Theoretically Recoverable in Waste Stream tonnes	Recovery %	Recovered tonnes	Market Value of Recovered Materials September 1989 FOB Yellowknife $ (1)
Newsprint	342	80	274	<-15,618>
Cardboard	1,219	25	305	<-6,710>
Glass	247	65 (3)	161	<-7,567>
Fe-Metals	169	12	20	<-640>
Aluminum Cans (2)	111	65 (3)	72	67,176 (4)
TOTAL			832	36,641

Notes:

(1) Market value FOB Yellowknife is calculated based on average shipping costs to Edmonton of $600 for a 20,000 lb. load, or $67 per tonne.

(2) Aluminum cans must be densified into bisquettes.

(3) This estimate assumes that half of all bottles and cans are sold by retailers and halt by restaurants and bars. Households recycle 80% and 50% of restaurants and bars participate through a specially arranged collection service.

(4) Assumes aluminum price, FOB Edmonton is $1,000 per tonne.

As becomes evident, the profits from the sale of aluminum cans more than cover the shipping costs of the other, less valuable materials.

Estimated capital and operating costs of a curbside recycling program are presented in Table 3.4,2.

TABLE 3.42

ESTIMATED COSTS FOR A CURBSIDE PICKUP RECYCLING PROCRAM

Capital Costs	Average Price $
Blue Boxes @ $8	22,800
Modified pick-up truck for collection	25,000
Forklift	30,000
Can desifier, with conveyor and fe-metal spearator	20,000
900 lb/hr. baler, manual load, manual tie	50,000
Scale	5,000
8 self tipping bins@ 3,oOO	24,000
Palletizing equipment and miscellaneous materials and equipment	20,000
SUB TOTAL	1%,800
15% Contingency	29,520
TOTAL	226,320

Amortized over 15 years @ 12% = $33,224 per year

* Note These represent maximum costs; smaller, less expensive balers are available

Operating Costs	$ per Year
Building lease 3,000 sq. ft. @ $12/sq. ft. with utilities	36,000
Collection vehicle O + M	4,000
Other O + M costs include materials	12,000
Two full time personnel (driver, equipment operator) with benefits	80,000
Part time secretarial and bookkeeping	10,000
SUB TOTAL	142,000
15% Contingency	21,300
TOTAL	163,300

cost Summary

Capital Costs	$33,224 per year
Operating Costs	163,300 per year
TOTM COSTS	$1%,524 per year

Not included in the above table are costs for an education program and advertising. The success and recovery rates of the program will depend on how informed the public is. Minimum annual costs can be expected in the S1 0,000 to $30,000 range.

Also not included in the above estimates are startup costs. These are difficult to quantify, since they will depend on the specific problems encountered during the beginning of recycling operations. Start up costs experienced by one of Edmonton's recycling companies were about 10% of total capital costs.

Curbside recycling can recover more materials than a drop off depot, however, costs are considerably higher, offsetting many of the gains made by recovering more materials. Aluminum cans are currently the only profitable materials and can help finance the program. However, subsidies would still be required if substantial quantities of other materials are recycled.

All calculations exclude any diversion credits for removal of wastes from the necessity of being landfilled.

Generally, quantities of materials recycled increase with the degree of convenience provided to the public. This convenience however is costly and is reflected in the cost estimates for the two options. Based on 10,S50 tonnes of residential, commercial and industrial waste (excluding construction) landfilled in 1989 in Yellowknife, waste reduction achievable by the two options presented is as follows

- Drop off depot - 4% reduction of the waste stream.
- Curbside recycling - 8% reduction of the waste stream.

These figures are in a range considered "normal" and indicate that recovery estimates are realistic

4.0 RECYCLING ENHANCEMENT MEASURES

4.1 GENERAL

In previous sections of this report, it has been established that most common materials are recyclable. However, economics vary considerably from highly profitable aluminum cans to low value newsprint. It has also been recognized that market values fluctuate considerably, constantly changing the economics of recycling. If major recyclable materials (paper, cardboard, glass, metals) are to be recovered under current market conditions, the total market value of the materials collected may be insufficient to cover collection, processing and transportation costs. **The shortfall of revenue to cover costs will vary, depending on the type of recycling operation (profit or non-profit).**

If communities or regions wish to recycle materials in spite of the identified economic obstacles, then recycling enhancement measures are required. These would require implementation by municipalities and by the Territorial Government and would impact the recyclability of the materials in various ways. Since each material category would be affected differently, a combination of Government measures may be required to achieve optimum results.

Before any legislative options are considered, a clear motivation for recycling must be established. Some of the more common reasons for recycling are

- **litter control**
- **waste reduction**
- **protection and conservation of environmental resources**
- **materials recovery**
- **political expediency/public demand**

When recycling is not profitable based on market value of the material alone, then costs of any implemented program will ultimately be passed on to the consumer, either in the form of taxes or higher consumer goods prices. The total costs of a program must be carefully weighed against motives for recycling and the expected benefits to the community.

The following section provides an overview of major recycling enhancement measures and their effects.

4.2 DEPOSIT SYSTEMS

Deposit systems were originally developed by soft drink and beer distributors to facilitate the return of re-usable glass beverage containers.

When non refillable beverage containers were introduced, Governments in many provinces adopted the deposit system as a form of litter control. Deposit systems have since evolved into one of the key legislative measures for the enhancement of recycling beverage and food containers.

Deposit systems have been applied to, and are suitable for beverage containers or other items that are easily quantified and identified. They are not suitable for such materials as newsprint, cardboard, miscellaneous scrap metals, waste oil or organics. They have been extremely successful in the control of litter and recovery rates of beverage containers are, depending on the height of deposit, anywhere from 78% to 90%. No other material recovery program or system achieves such a high success rate.

While there are many variations on how a program can be operated, deposit systems are always based on a circulation of money. A deposit is charged by the manufacturer of a beverage and passed along the distribution line to the consumer, who, in turn, can reclaim this deposit from the manufacturer when the beverage container is returned. Those deposits not collected by consumers accumulate in a pool which is often used to help finance the recycling operation. The ownership of this pool of money must be determined at the beginning of a program.

Originally, when deposit systems were introduced for refillable containers, the value of a deposit was set to cover the replacement costs of containers not returned. With nonrefillable containers, the deposit is an artificial incentive for the consumer to return the container to the manufacturer. The manufacturer is then free to dispose of the containers or sell them for a profit.

The deposit itself is, after completion of the recycling cycle, cost neutral to the product. However, a second less visible cost is also involved, namely handling costs. These are incurred from the collection and handling of the recyclable, including transportation to markets. Even after revenues from sale of materials, there is usually a net fee per container that must be built into the price of the beverage in order to pay for the deposit recycling system. Handling fees traditionally range between 2 and 5 cents per container, depending on specifics of the selected system. These costs are passed on to the consumer in the price of the beverage and are usually not visible.

Beverage container recycling based on deposits has two major drawbacks, Firstly, it is expensive and must be paid for by the consumer of beverage containers. The money spent to finance the program is not available for spending on other goods and services. The second disadvantage of the beverage container deposit system is that it is limited to beverage containers. Other ways must be found to recycle paper, cardboard, mixed metals and plastics.

4.3 SUBSIDIZED RECYCLING

Wherever recycling of certain materials is not economical based on the value of the materials themselves, subsidies can provide the lacking economic incentives to recycle such materials. There are numerous methods of subsidizing recycling operations; some of the more common ones are discussed below.

4.3.1 Curbside Pick-up Recycling

Curbside recycling is a common method practised by municipalities to collect large quantities of household recyclable, and is presented in detail in Section 3.4, Curbside recycling is a high profile method of community recycling and has recently become very popular in the large municipalities in Ontario and also in Edmonton, Alberta.

Curbside pick up programs utilize special containers “blue boxes” in which recyclable are placed and put out to the curb on garbage collection days. A separate truck picks up the recyclable on the same day as regular garbage pick up. Curbside pick up is limited to the servicing of single family dwellings up to and including 4-plexes. Multiple family dwellings and commercial/industrial establishments, must be serviced by a separate type of recycling system. .

Due to its convenience, curbside recycling programs are known for their high participation rates, which range from 70% to 85% of the residences provided access to the program. Curbside programs however, are costly. Due to the requirements for expensive facilities with materials handling equipment (baler for paper and cardboard, shredder for plastics, conveyors, forklift, front end loader), curbside programs are more suitable for large communities where a certain economy of scale can be achieved. Curbside programs are not profitable by themselves and must be heavily subsidized, Subsidies are dependent on the size of the community and the number and types of materials collected. Assuming a collection of paper, cardboard, glass, metals and plastics, approximate subsidies per tonne of material recycled would be in the range of:

City of 600,000-$100 per tonne
City of 60,000-$150 per tonne
City of 12,000- $150+ per tonne

Costs for smaller communities were not estimated since programs would have to be individually tailored to the specific needs of the community. Modified curbside collection for smaller communities might include collection and sorting of materials without further processing and then shipment to a central facility where processing from various communities could take place.

In large cities, curbside recycling programs typically can achieve a waste reduction of up to 5% of the total waste stream or 15% of the residential waste stream.

4.3.2 Drop-off Recycling

Another form of subsidized recycling, more suitable for smaller communities, is the drop off system (see also detailed description in Section 3.3). Drop off recycling refers to the establishment of one or several depots in a community where residents can drop off collected quantities of specific recyclable materials. The common materials collected for any type of community program are paper, cardboard, glass and metals. Some communities are experimenting with plastics and in areas where landfill space is at a premium, drop off depots also exist for organic and yard wastes.

There are two types of drop off depots, the unmanned and the manned facilities, Unmanned facilities usually consist of a row of separate bins for the various materials to be collected. Residents separate materials and drop them off in these bins on a regular basis. When full, they are picked up by the recycling operator and brought to a central facility where materials are inspected, sorted if necessary, and consolidated for shipment to markets.

Manned drop off systems are similar to the unmanned, except that an operator is available who receives and inspects materials and can also provide assistance to handicapped or elderly people returning materials.

Drop off depots traditionally do not achieve high recycling rates. Unmanned depots might achieve a 2% reduction of the solid waste stream or 5% reduction of the residential waste stream, while manned depots are expected to fare slightly better due to the personal service provided.

Costs, or required subsidies, are difficult to quantify, since they depend on the type and number of materials collected. If there is a beverage container recycling program in place and the high value aluminum cans are already removed from the waste stream, then very few materials of any value remain to be collected, and whatever is collected, must be heavily subsidized to pay **for** collection and transportation costs. Subsidies for drop off operations in Alberta can range from $50 to over $100 per tonne of materials collected.

4.3.3 Direct Subsidies

A third method of subsidizing recycling operations directly is when the Government enters into an agreement with **a recycler** (this is often a nonprofit group) and guarantees to compensate for low market values of materials. For example, if a **recycler** requires $70 per tonne for newsprint to make the operation viable, but the actual market price of used newsprint is only $15 per tonne, then the subsidy paid would be $55 per tonne of materials sold on the marketplace. Subsidies would be variable and could theoretically reach zero if a high demand for recycled materials causes prices to rise sufficiently, The value of scrap aluminum cans could also help offset the costs of recycling other lower value materials such as newsprint.

The Government can also get involved in recycling itself, Although uncommon, it is feasible for Governments to integrate recycling into their waste management operations. This approach would be reasonable, for example, if the city of **Yellowknife** were to operate a baling facility and transfer station for its solid wastes. The same facility could be used to sort paper, cardboard and plastics and to bale them for shipment to markets. Although difficult to quantify, such a utilization of resources could result in low cost materials recovery,

An example is the office paper recycling program being initiated for GNWT offices in **Yellowknife.** Due to the complete integration of recycling in day to day operations, determination of actual recycling costs will be difficult, but the utilization of existing resources, facilities and infrastructure will undoubtedly lead to a cost effective removal of materials from the waste stream,

4.4 RESTRICTIVE LEGISLATION

Legislation restricting the types of materials used for certain consumer applications has, traditionally been limited to beverage containers. Most recently, in some regions of the **U.S.A.,** legislation is restricting the use of certain plastics in packaging in **an effort to** reduce the quantities of plastics in the waste stream.

In the past, beverage containers were sometimes restricted to support local bottlers or brewers as well as to ensure the use of refillable containers. It was generally considered that a refillable glass bottle is more efficient than the aluminum can or plastic container. However, local bottlers and brewers are being replaced by large, efficient, centralized plants and it has also been recognized that the aluminum can is actually more energy efficient than the reusable glass bottles when all aspects of transportation, handling, and recycling are taken into account.

The benefits of the single serving size aluminum can **for beverage** containers are indisputable. The material is light, unbreakable, easily recoverable and condensable **and profitably recyclable. This raises the question if** it might not be desirable to limit the type of container for single serving beverages (under 500 *ml)* to the all aluminum can. The advantages are obvious, large quantities of glass, which are difficult and costly to recycle, would be eliminated. Also, costly subsidies for the recycling of glass would no longer be required. The inherent value in aluminum is sufficient to warrant its collection and shipment to markets.

Beer **would be the main product affected by such legislation.** Beer bottles currently make Up the largest proportion of glass beverage containers in the NWT (it should be noted, however, that beer bottles in the NWT carry a deposit and the majority are already being returned for re-use). While aluminum beer cans are making inroads and capturing an increasing part of the market share, there appears to be some consumer preference for beer from glass bottles. In the soft drink industry, glass bottles have virtually disappeared in favour of the all-aluminum can, or for larger containers made of P.E.T. plastic Wine and liquor containers would not be affected by this legislation and would continue to be made of glass.

The elimination of the glass beer bottle in favour of the all aluminum can offers the following possibilities. It would no longer be necessary to implement a costly deposit recycling system, since aluminum cans could be recycled profitably based on the value of material alone. Other recycling operations, set up to handle paper, cardboard, and other materials, could handle the glass liquor and wine bottles as well as any plastic bottles, If these operations are also set up to recover aluminum cans, increased profits from the large quantities of cans could help offset the necessary subsidies for the recycling of other types of materials.

The major disadvantage of container restrictions is that it interferes with the free market system and natural devolpment in the use of materials.

Restrictive legislation for plastics packaging does not appear to be a suitable method for reducing plastic wastes. Packaging is evolving at a rapid pace and proper packaging is essential for the movement of goods into and around the NWT. Recycling technologies for mixed post consumer plastics are being developed and are expected to be available in the very near future. Properly disposed of in a landfill, plastics are not considered to be a threat to the environment, since they remain inert and do not decompose (their long life makes if preferable to recycle plastics, rather than bury them). Littering is considered a nuisance, but it can be controlled by other means. Restrictive legislation on packaging would unnecessarily raise costs to consumers.

5.0 REVIEW OF EXISTING RECYCLING OPERATIONS

5.1 RECYCLING IN THE NWT

A number of programs and initiatives have recently begun to recycle certain materials in the NWT, or are planned for implementation in the near future, Major initiatives are presented below.

Ecology North

Ecology North is a territory wide volunteer recycling organization founded in Yellowknife. In June 1989, a demonstration recycling program was started in the City of Yellowknife, which consisted of a drop off depot on the parking lot of the Yellowknife direct charge Co-op, and a pilot curbside pick-up program encompassing 50 residences.

Initially, the program was financed with a $10,000 start-up grant from the Territorial Government, $5,000 was for material and equipment and an additional $5,000 was provided for a part-time co-ordinator for four months. Most of the recycling work is carried out by volunteers and all of the curbside pilot program work is voluntary, Ecology North has applied for an additional grant from the Environmental Partners Fund to pay for part-time staff for the next two years.

Considerable progress has been made since the program was originally launched. A warehouse has been donated by a local firm that, after insulation **and installation of a portable heater,** will allow operations during winter months. A can densifier has been lent to the organization by Pacific Metals Ltd., Vancouver, B.C.

Materials collected so far are aluminum cans, steel cans, plastic shopping bags and glass. Collection of plastic shopping bags has since been dropped, since there is no market for this material. Markets for newsprint and cardboard are also poor so that the collection of these materials has been deferred until prices improve. Ecology North receives all office papers collected by the GNWT collection program, and arranges for shipping the paper to southern markets.

Quantities collected at the Co-op depot are low, possibly due to the fact that the depot was open to Co-op members only. A new facility in Kam Lake is expected to collect significantly higher quantities of materials.

Future plans focus on obtaining funding for part-time staff, and a proposal has been submitted to the Environmental Partners Fund to help cover 2 years operating expenses. The pilot curbside program, which is being continued on a voluntary basis, will not be expanded due to the high amounts of labour involved. Ecology North is also considering the establishment of neighborhood depots to make recycling more convenient for residents of Yellowknife and consequently to increase recovery rates of materials.

In July of 1989, the GNWT, a Department of Government Services, began a recycling program for office papers. Using the blue box, (adapted from curbside programs) as a collection container, office papers are being collected in the following categories: computer paper, ledger paper and other office papers. in total, about 2,000 employees will participate in this collection program,

Financial aspects and logistics of the program are managed by the Department of Government Services, and collection, transportation to Government Services warehouse, transfer into bins on pallets and final packaging are all activities that will be integrated into the service organization of the GNWT

One of the problems facing this program is how to ensure confidentiality of the information contained in the office paper after it leaves GNWT responsibility. A legal arrangement between Ecology North and the buyer of paper is being considered to mitigate this. Another potential problem is the contamination of fine papers by lower grade papers or other materials.

Since the program has only recently started, actual quantities of recovered materials are unknown. It is estimated by the Department of Government Services that about 245 tonnes of office papers can be recycled annually.

Town of Inuvik

The Recreation Department in the Town of Inuvik launched an aluminum can recovery program in June of 1989. With a start-up grant from Environment Canada, three large yellow bins were purchased and set up in the Town. Residents are encouraged to deposit aluminum cans and businesses are asked to separate these cans for separate pick up by the Town. Collected cans are sold to a private firm which pays the Town 2 cents per can,

Since the operation has only recently begun, participation rates have been low and the Town is looking for ways to increase recovery of aluminum cans.

Town of Iqaluit

The Town of Iqaluit has purchased two vans from the GNWT and has begun collecting aluminum beer cans from bars for recycling (home pick-up can also be arranged). The cans are currently being stockpiled until the quantity warrants compaction and shipment to markets. Arrangements have been made with First Air, which will take aluminum to southern Canada at no cost to the Town (backhaul).

Collection is limited to beer cans, since many softdrink cans still contain steel, which contaminates the collected aluminum. The merchants in Iquluit have spoken out against deposits, which they feel is a cost (type of tax) they do not wish to pass on to their customers.

Beer Bottle Recyclers

Beer bottles entering the NWT have a 10 cent deposit on them from Alberta Brewers. Bottles returned to Alberta result in a recovery of the 10 cent deposit. This has spurned four companies to get involved in the recovery and return of re-usable glass beer bottles. Two firms in Yellowknife, one in Hay River and one in Inuvik, collect beer bottles from restaurants and taverns and from private individuals. A portion of the deposit is paid to the party delivering the bottles. The remaining portion is used to cover transportation costs and handling of the bottles.

Two of these operations are connected with transportation companies or operated by transportation companies which provides a degree 'of vertical integration and cost savings.

Recovery rates are impressive, For Yellowknife and Hay River, they are well over 90%. For the whole northwest region, in which beer bottles are distributed, recovery is still a remarkable 75%.

NWT Liquor Commission

Concerned about the littering of the NWT with alcoholic beverage containers, the NWT Liquor Commission has forwarded a proposal to the Minister to consider an alcoholic beverage container recycling program. The proposal would place deposits on all alcoholic beverage containers to encourage the return of these containers. The proposal also foresees shredders being provided to communities by the government to shred all metals, plastics and glass. Those materials with a market value could then be shipped to markets while lower value materials could be safely landfilled.

There is no fixed timetable for this program; however, it is anticipated by the Liquor Commission that after approval, it could be implemented within six to twelve months.

5.2 RECYCLING IN OTHER PROVINCES

Government recycling programs are presented for Yukon, Alberta and Saskatchewan, which **are close** to and more similar to the NWT than other Provinces.

All three regions have provincial/territorial legislation in place to recover beverage containers. Other household recyclable such as paper, cardboard and mixed plastics are not affected by these programs and are left to municipalities to recover or landfill. Only the City of Edmonton has a major recycling project, a curbside collection program for residences which was implemented *in* late 1988.

Yukon Territories

Similar to the NWT, beer bottles coming from southern provinces (in this case, British Columbia), carry a 10 cent deposit, which is refunded when bottles are returned. This program has and continues to work well with recovery rates reported between 90% and 100%. It is not known, however, how many beer bottles are purchased in B.C. and returned in the Yukon, or vice versa,

Three years ago, deposits were introduced for beer cans and other liquor containers. Liquor containers carry a 25 cent deposit, which has resulted in a 90% recovery rate. Beer cans originally carried a 5 cent deposit, and this resulted in only a 50% recovery rate. Recently the deposit on beer cans has been raised to 10 cents.

Beer cans continue to be returned to Pacific Brewers in Vancouver, and aluminum cans are shipped to Pacific Metals Ltd., Vancouver. Glass bottles are crushed and landfilled. PET plastic containers are seen as a potential problem when quantities increase.

Softdrink cans and other beverage containers are not covered by this program or any other official territorial program. A new Environmental Protection Act is being prepared in the Yukon Territories and is expected to address all beverage containers under the heading of litter control.

Alberta

The Alberta Beverage Container Act (BCA), was introduced in 1971 and requires that beverage manufactures in the Province establish a refund and collection system for designated refillable and non-refillable beverage containers. Under the BCA, consumers receive a deposit refund for eligible containers upon their return to a licensed depot,

The BCA was originally intended to control litter of beverage containers in the Province of Alberta. It has been extended and modified several times to improve efficiency and expand the types of containers covered under the Act. Domestic beer cans and refillable beer bottles are exempted since they are successfully handled by the Alberta Brewers Agents.

Under the BCA, the Minister of Environment licenses universal depots which must accept all designated beverage containers for their cash deposit value. The depots also sort and prepare containers for their return to the industry. The beverage industry itself has hired agents to collect, transport and dispose of the recovered beverage containers. Wine and spirit containers are the responsibility of the Alberta Liquor Control Board, who have also designated an agent to handle and process the returned containers.

There are two additional costs on every beverage sold in Alberta. One is the deposit, which is reimbursed to the consumer when he returns the used beverage container. The second cost is hidden and consists of a commission for the licensed depot to cover opreating costs. These commissions are adjusted from time to time to reflect depot requirements. Handling commissions, which are over and above deposits, averaged 35- 40 cents per dozen containers in 1987.

Alberta' beverage collection system is effective and on average, collects 80% or more of the beverage containers covered by the program.

Saskatchewan

Until 1988, Saskatchewan disallowed the use of aluminum or plastic beverage containers. Only reusable glass bottles were permitted. Industry executed deposit and recovery programs were in place.

In 1988, the Ministry of Environment and Public Safety, lifted the restrictions on aluminum and plastic containers after a recycling program for them had been put into place. The government has contracted the collection and recycling of aluminum and plastics to the Saskatchewan Association of Rehabilitation Centres, (SARC). SARC is the sole authorized agent who may pay the deposit on returned cans. Thirty-two collection depots have been set up as well as two processing centres for aluminum, SARC has turned recycling into a major initiative **for disabled persons.** Over 100 jobs have been created for disabled individuals.

Similar to Alberta, containers covered under this program have two additional costs attached, the deposit and handling fee. Deposits are 5 cents for aluminum cans 10 cents for 1 litre and 2 litre PET plastic containers. The handling fee, which is paid to SARC to pay for operation and collection of recycling systems, is 2 cents per aluminum can and 5 cents for the plastic containers.

5.3 REVIEW OF POSSIBLE IMPACT OF RECYCLING LEGISLATION

The recycling legislation discussed above, applies only to beverage containers. Since these are, however, one of the greatest sources of litter, the introduction of a beverage container recycling program, similar to Alberta or Saskatchewan's program would have a noticable impact. The Alberta program is the more comprehensive, but also the more costly. If a program similar to the one in Saskatchewan were adopted, it would have to be expanded to include glass liquor and wine bottles.

In order to properly assess the possible impact of recycling legislation, a hypothetical deposit system for the NWT has been assumed. The system is fashioned to cover all containers covered by the Alberta Beverage Container Act and deposits would be the same as in Alberta so that the systems do not compete.

Costs of the hypothetical system can be calculated based on quantities identified in previous sections of the report. Deposits would be 5 cents per container, smaller than 1 litre and 20 cents for all containers 1 litre and larger. Beer bottles would continue to carry a 10 cent per container deposit. Recovery rates are conservatively estimated at 80%. The total quantity of deposits that would be in circulation annually (based on 1989 quantities) and the total quantity of unrefunded deposits are presented below in Table 5.3.1.

TABLE 5.3.1

BEVERAGE CONTAINER DEPOSIT SYSTEM: DEPOSIT COSTS

Container Type	Quantity per Year thousands	Deposit per Container $	Total Deposits $ per Year	Return Rate %	Unrefunded Deposits $ per Year
Aluminum Can (under 500 ml)	16,830	0.05	841,500	80	168,300
Glass Beer Bottle	6,787	0.05	339,350	80	67,870
Glass Bottles up to 1000 ml	855.7	0.10	85,570	80	17,114
Glass Bottles over 1000 ml	270,9	0.20	54,170	80	10,830
plastic Bottles 1000 + 2000 ml	85	0.20	17,000	80	3,400
TOTALS			1,337,590(1)		**267,514**(2)

Notes:

(1) These are the total deposits paid for by the consumer, which must be returned to the consumer when the beverage container is returned.

(2) This is an assumed portion (20%) of the total deposits that is unclaimed because 20% of containers are typically not returned.

Table 5.3.2 provides an estimate of handling commissions that might be required to finance the hypothetical beverage container deposit system. Not calculated are possible revenues from the sale of materials, or expenses connected with the disposal of them.

TABLE 5.3.2

BEVERAGE CONTAINER DEPOSIT SYSTEM: HANDLING COSTS

Container Type	Containers Handled per Year Thousands	Handling Fee per Container	Total Fees $ per Year
Aluminum Can (under 500 ml)	13,464	0.02	269,280
Glass Beer Bottle	5,430	0.02	108,600
Glass Bottle up to 1000 ml	684.6	0.02	13,692
Glass Bottle 1000 ml and larger	216.7	0.05	10,835
Plastic Bottles 1000 + 2000 ml	68	0.05	3,400
TOTALS			405,807

The figures in the above tables for deposits and handling fees are hypothetical and can be modified to suit actual conditions. Fees and deposits must be considered **flexible and adjusted to suit the** needs of the program when implementation details are being prepared. For this study, the estimates provide an order and magnitude or potential fees available to finance the program.

Annually, over $1.3 million would be paid out by the consumer in deposits, of which about 80% would be refunded, leaving an unclaimed deposit fund of about $260,000. Based on the assumed **per container handling fees, an additional $400,000** would be generated to pay for the implementation and operation of a beverage container recycling program. During the planning of the program, it must be decided who applies the deposit and who ultimately owns the unrefunded deposits. It should be noted that with increasing return rates, the quantities of unrefunded deposits drop, while handling costs increase.

Not addressed in the above estimates are the hidden administration costs of the GNWT for the implementation and operation of a beverage container deposit system.

The environmental impact of such a program would be considerable, Although there **would be little reduction** in total solid waste quantities, the problem of beverage containers littering the pristine northern landscape would be addressed.

6.0 SUMMARY AND CONCLUSION

The materials profile, information and' analyses presented in this report indicate that:

- Reduction of waste at source and re-use of materials are the most desirable forms of waste minimization Recycling, the third R of waste management, is the subject of this report Recycling removes materials from the waste stream that have a value and can be used as secondary raw materials

- Substantial quantities of household waste materials in the NWT are available for recycling in the following order:

  - Cardboard -4,600 tonnes per year
  - Mixed plastics - 1,100 tonnes per year
  - Glass beverage containers -880 tonnes per year
  - Mixed metals - 660 tonnes per year
  - Newsprint - 420 tonnes per year
  - Aluminum cans -260 tonnes per year
  - PET plastics - 21 tonnes per year

- The market value of the reviewed materials, F.O.B. Yellowknife, indicates that only two materials have • positive market value when shipping costs are deducted Estimated material values, September 1989, are as follows

  - Aluminum cans; $933 per tonne
  - PET plastics; $13 per tonne •
  - Cardboard; -$22 per tonne
  - Mixed fe-metals; -$32 per tonne
  - Glass; -$47 per tonne
  - Newsprint; -$57 per tonne •
  - Mixed plastics; -$150 per tonne •

Note

• indicates uncertain markets

- The existing deposit system for beer bottles works well and achieves over 90% recovery in larger communities such as Yellowknife and Hay River and an overall recovery rate of 72% for the entire western NWT.

- Glass is slowly being replaced by aluminum and plastics as a material for beverage containers. The proportion of beer cans to glass bottles is increasing. Glass softdrink containers are no longer used.

- The general public is generally supportive of recycling. Small collection programs are being organized such as:

  - Drop-off depot and pilot curbside programs in Yellowknife
  - Aluminum can collection in Inuvik
  - Paper collection in the GNWT offices in Yellowknife
  - Aluminum can collection in Iqaluit

  In addition, the NWT Liquor Control Commission is considering the implementation of a deposit system for all alcoholic beverage containers for the purpose of litter control.

- Recycling in the NWT faces special obstacles, over and above those experienced in southern, more populated areas:

  - Low volumes of materials (poor economies of scale for local processing)
  - large geographical spread of materials
  - limited transportation modes
  - Costly transportation of materials to markets

  It is not economical to recycle some materials due to these obstacles. For materials which are a litter nuisance but environmentally benign (such as glass beverage containers), focus might be on collection and disposal rather than recycling.

- Drop-off depots appear to be the most suitable method of collecting household recyclable materials in the NWT. While curbside collection may offer higher materials recovery rates, the system is very costly and is less suitable for the population densities common to the NWT.

- Aluminum cans by themselves can be profitably recycled, without the need for government subsidies. In an overall recycling program, profits from the sale of aluminum could be used to subsidize less lucrative materials.

- The use of deposit systems to enhance the recovery of beverage containers is effective but costly. Over 80% recovery of containers can be achieved but the cost to the public of the NWT could be well over $500,000 per year in program operating fees and unrefunded deposits.

- Beer bottles make up the majority of glass containers. Legislation restricting the material used for single serving size beverage containers to all aluminum (no hi-metal cans) would reduce the quantities of glass in the waste stream. However, there is a preference by some beer drinkers for glass, containers and the existing recovery and reuse of beer containers works reasonably well for those areas accessible by road.

- Provincial and Territorial recycling legislation outside of the NWT is limited to beverage containers and was introduced primarily to control litter. Recycling of other household materials is sometimes implemented by larger cities, which utilize costly curbside collection programs to reduce the quantities of waste going to landfill.

It can be concluded that the value of aluminum from beverage containers will be increasingly recognized by entrepreneurs which could result in the formation **of numerous smaller businesses competing** for the material. If non-profit organizations are to use profits from aluminum sales to subsidize recycling other materials, they must be ensured access to all aluminum cans,

The proposed program by the NWT Liquor Commission to recycle alcoholic beverage containers is encouraging and **could have a substantial** impact on the quantities of glass being disposed in the NWT. However, it would only affect about 1/3 of the aluminum beverage containers and a small fraction of the PET beverage containers **used in the NWT.**

With exclusive use of aluminum for single serving softdrink containers and the increasing use of PET plastics, there is a need for a comprehensive recycling policy that encompasses **all** beverage containers, as well as any other materials that **are** of value, or are perceived to cause a litter or waste management problem.

An integrated program, recovering more than aluminum and extending beyond one or two major communities, **could result in** lower unit costs due to the better economies of scale, while providing a **service** to all NWT residents. The profits from the sale of aluminum **could be used to help offset the costs of recycling other materials.**

Recycling of common household goods in **the** NWT is **in its infancy and now is a** good time to set the direction for the future. A position and strategy by the GNWT on recycling could pave the way for the development of an integrated, **efficient** recycling infrastructure, specifically tailored to the needs of the NWT. **A** clear policy statement, supported by regulations and guidelines if required, would give entrepreneurs, businesses and recycling groups the necessary direction to work towards these goals.

APPENDIX A

References

PERSONAL COMMUNICATIONS AND INTERVIEWS

Anderson, Steve; Recycle Systems, Wa., USA

Booth, Andrea; Ecology North, Yellowknife

Campbell, Bertha; North Star Services, Inuvik

Canadian Airlines Cargo, Yellowknife

Canarctic Printers, Yellowknife

Christie, Joe; Northwest Transport, Yellowknife

Courtoreilly, Ron; NWT Liquor Commission, Hay River

Curtis, Peggie; Town of Inuvik, Recreation Department

Dixon, Vince; GNWT, Dept. of Government Services

Fairly, Joanne; Yukon Liquor Corp., Whitehorse

Fuller, Steven; YTG, Whitehorse

Hoffman, Wendy; Yukon Liquor Corp., Whitehorse

IGA, Yellowknife

Johnson, Don; GNWT, Supply and Services, Yellowknife

Lotzkar, Joe; Pacific Metals Ltd., Vancouver, B.C.

May; J & M Wholesale, Hay River

McCullum, John; Ecology North, Yellowknife

NWT Air Cargo, Yellowknife

Phillpot, Norman; NWT Liquior Commission

Reid, Kyle; NWT Liquor Commission, Hay River

Super-A-Foods, Yellowknife

Swetnam, Roger; Paper Chase Recyclers, Edmonton

Walker, Roger; Peterson & Auger, Yellowknife

Weaver, Bob; Territorial Beverages, Yellowknife

Yaceyko Ted; The Sportsman, Yellowknife

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APPENDIX B

Operating Cost Scenarios

Low-cost
&
High-cost Projections

prepared by

SCIENCE INSTITUTE OF THE NWT

APPENDIX

The purpose of the preceding study is to gather information which will serve to put together a business plan **for recycling** in the NWT.

The following pages prepared by the Science Institute **of the NWT** (SINT) summarize this information **in table form, and the calculations are considered reasonable** (by SINT) based on the data presented.

The conclusions drawn by SINT from the analyses of the data suggest that recycling can play a part in sound management of our renewable resources.

MATERIALS DISPOSED OF AND THEORETICALLY RECOVERABLE (IN METRIC TONS)

MATERIAL	YK	FT. SMITH	INUVIK	KITIKMEOT	KEEWATIN	BAFFIN	TOTALS
NEWSPRINT							
DISPOSED	488	32	21	11	14	29	59
RECOV 70%	342	22	15	8	10	20	41
OFFICE PAPERS							
STANDARD PAPER							
DISPOSED	258	225	120	108	75	164	95
RECOV 75%	194	169	90	81	56	123	71
FINE PAPER(1)							
DISPOSED	258	225	120	108	75	164	95(
RECOV 75%	194	169	90	81	56	123	71
CARDBOARD							
DISPOSED	1741	1415	992	508	666	1331	6653
RECOV 70%	1219	991	694	355	466	932	4657
MIXED METALS							
DISPOSED	338	296	193	100	131	262	1320
RECOV 50%	169	148	97	50	66	131	661
ALUMINIUM CANS							
DISPOSED	123	56	37	19	19	40	294
RECOV 90%	111	50	33	17	17	36	264
GLASS CONTAINERS(2)							
DISPOSED	274	261	126	143	44	132	980
RECOV 90%	247	235	113	129	40	119	883
MIXED PLASTICS							
DISPOSED	1049	994	649	336	441	880	4349
RECOV 25%	262	249	162	84	110	220	1087
P.E.T.							
DISPOSED	6	5	3	2	2	4	22
RECOV 90%	5	5	3	2	2	4	21

1- FINE PAPER IS 50% OF TOTAL OFFICE PAPER GENERATED.
2- GLASS CONTAINERS HERE REFERS ONLY TO THE BEVERAGE CONTAINERS AVAILABLE FOR RECYCLING. SEE TABLE 2.4.1

MARKET VALUES OF RECOVERABLE MATERIALS PER METRI C TON
AND
PERCENT RECOVERY FOR MATERIALS BASED ON TWO DIFFERENT COLLECT IN SYSTEMS

	NEWSPRINT	FINE PAPER	CARDBOARD	MIXED METALS	ALUMINIUM CANS	GLASS CONTAI NERS	MIXED PLASTICS	PET
MARKET VALUE : S/METRIC TON	10	60-130 ● 60. *100	45	35	1000-1800 ● 12D0	55-77 ● 77	66	110
% RECOV. RATE : DROP OFF	40	50	12	6	30	30	12	30
% RECOV. RATE CURBSIDE	80	50	25	12	65	65	25	65

WE CALCULATE FROM 10% TO 75% LOSS OF MATERIALS AT THE CUTSET , LEAVING FRCU 25% TO W% OF TOTAL MATER IALS AVAILABLE FOR RECYCLING . WE FURTHER CALCULATE THAT DIFFERENT COLLECTION SCHEMES WILL PRODUCE DIFFERENT PERCENTAGES OF RECOVERABLE MATERIALS. FOR EXAMPLE , CURBSIDE VERSUS DROP-OFF WILL HAVE DIFFERENT RECOVERY RATES. THE REVENUES GENERATED UNDER THE TWO COLLECT ION SCHEMES REFLECT THESE DIFFERENCES .

	REVENUES YK	FRT. SMITH	INUVIK	KIT IKMEOT	KEEWATIN	BAFFIN	TOTAL
DROP-OFF REVENUES $	S71,731	S44,671	S27,084	S18,365	S15,156	S32,811	S209,818
CURBSIDE REVENUES S	S136,302	S80,694	%9,818	S31 ,993	S27,300	S58,987	$385,096
UNREFUNDED DEPOSITS S	S72, 024	S43, 072	S32, 925	S34,983	S27,922	S56, 590	S267,516
RETURNED DEPOSITS(1)	S288,096	$172,291	S131,700	S139,932	S111,691	S226,360	S1,070,070

1-DEPOSITS PAID TO CUSTOMERS UPON RETURN OF CONTAINERS.
STANLEY CALCULATES ADD ITIONAL HANDLING COSTS ASSOCIATE WITH WITH RECOVERY OF BEVERAGE CONTAINERS OF S405,807.

DropOff Depots (Low Capital/Operating)

	Yellowknife	Hay River	Inuvik	Cambridge	Rankin	BatYin
Revenues:						
Market Value	$71,731	$44,671	$27,084	$18,365	$15,156	.%32,81 1
Deposit/Returns	o	0	0	0	0	0
Total Revenues	$71,731	$44,671	$27,084	$18,365	$15,156	$32,811
Expenses:						
L.T. Debt	$16,177	$3,492	$3,492	$3,492	**$3,492**	$3,492
Wages 1-F.T. Operator	30,000	30,000	30,000	30,000	30,000	30,000
Wages 1-P.T. Secretary	**10,000**	**14,400**	**14,400**	**14,400**	**14,400**	**14,400**
O & M (5 -7% Cap)	5,000	1,900	1,900	1,900	1,900	1,900
Building Rent and Utilities	7,500	10,500	10,500	10,500	10,500	10,500
Sub Total	$68,677	$60,292	$60,252	$60,252	$60,252	$60,252
15-20% Cont.	7,875	11,360	11,360	11,360	**11,360**	11,360
Transport. 1,	75,284	38,090	52,290	71,082	73,260	151,668
Total Expenses	**$151,836**	**$109,742**	**$123,942**	**$142,734**	**$144,912**	**$223,320**
Surplus <Deficit>	<$80,105>	<$65,071>	<$%,858>	<$124,369>	<$129,756>	<$190,509>

Note to Statement

1- A non-profit organization might be able to eliminate transportation costs by issuing receipts for tax purposes **in** lieu of cash to transport/shipping companies!

2- Freight rates are assumed as follows:

Yellowknife-Edmonton $67. M.Ton **Backhaul;**
Hay River-Edmonton $45. M. Ton **Backhaul;**
Inuvik-Edmonton $100. M.Ton **Backhaul;**

Kitikmeot, Keewatin, & **Baffin backhaul** rates on sealift $220. M.Ton,

LOW ESTIMATE:

Estimated Cost of Operating Recycling Depots in Regions

Capital Costs:			**Average Price $**
*	1-	Pallet jack	$2,500.00
	2-	Can Flatner	3,500.00
	3-	Baler (Manual, Conveyor & Strapping)	6,000.00
•	4-	Scale	5,000.00
	5-	8 Self tipping bins @$ 577./each	4,616.00
	6-	Strapping Equipment & Mist	1,000.00
		Sub Total	$22,616.00
	7-	**20% Contingency**	4,523.00
		Total Capitol	**$27,139.00**
		Amortized over 15 years @ 10% Interest	**$3,492 .00/yr.**

Operating Costs:			**Annually $**
	1.	Wages, 1 F.T. Operator& benefits	**$30,000.00**
	2.	P.T. Secretary& bookkeeper	14,400.00
	3.	Operating Maintenance (7% Cap. Costs)	1,900.00
***	4.	Building Lease & Utilities @ $7./Sq. ft. x 1500 sq. ft.	10,500.00
		Sub Total	$56, 800.00
	5.	20% Contingency	11,360.00
		TOTAL OPERATING	**$68,160.00**

* **In remote communities, it maybe more practical to rent or get the loan of the local forklift and scale, rather than buying them.**

*** Rent and cost of utilities may vary significantly depending on whether the building is used continuously or just for 1 or 2 days/week! It would be more economical to **own outright a warehouse/building! A suitable Park-All could be purchased for $7,000-$15,000, Canadian.**

Profit and Loss Statement Drop-Off Depots:

(Low Capital/Operating)
Here we will assume that a return or deposit system for all beverage containers exists. The resulting profit and loss statement reflects the increase in revenues.

Revenues

	Yellowknife	Hay River	Inuvik	Cambridge	Rankin	Baffin
Market Values	$71,731	$44,671	S27,084	S18,365	$15,156	$32,811
Unrefunded Deposits/ Returns	$72,024	43,072	32,925	34,983	27,922	56,590
Total Revenues	$143,755	$87,743	$60,009	$53,348	$43,078	$89,401
Expenses:						
Total Expenses as per	$151,836	$109,742	$123,942	$142,734	$144,912	$223,320
<Deficit> Surplus	<$8,081. >	<$21,999. >	<$ 63,933.>	<$ 89,386.>	<$101,834>	<$133,919>

Elimination of transportation costs changes the P.&L. picture thus

<Deficit > Surplus	$67,203.	$16,091.	<$11,643. >	<$18,304, >	<$28,574. >	$17,749.

Controlling building rent and utilities through ownership of building and part time operation would hold costs down to $7,500. This would further enhance the P.&L. picture.

< Deficit> Surplus	S67,203.	$19,091.	<$8,643, >	<$15,304.>	<$25,574. >	$20,749.

HIGH ESTIMATE:

Estimated Costs of Operating Recycling Depots in Regions

Capital Costs:		**Average Price $**
1-	Pallet Forklift	$20,000.00
2-	Can Flatner	8,800.00
3-	Baler	18,000.00
4-	Scale	5,000.00
5-	8 Self tipping bins @$577./each	4,616.00
6-	Strapping Equipment & Mist	1,000.00
	Sub Total	$57,416.00
7-	20% Contingency	11,483.00
	TOTAL CAPITAL	$68,899.00
	Amortized over 15 years @ 10% Interest	$8,880.00

Operating Costs:		**Annually $**
1-	Wages, 1 F.T. Operator& benefits	$30,000.00
2-	P.T. Secretary& bookkeeper	14,400.0(3
3-	Operation & Maintence (7% Capital Costs)	4,378.00
4-	Building Lease & Utilities (@ $17./sqo ft. x 1500 sq. ft.)	25,500.00
	Sub Total	$74,278.00
5-	20% Contingency	14,855.00
	TOTAL OPERATING	$89,133.00

Profit & loss Statement
DropOff Depots. (High Capital/Operating)

Regions

	Yellowknife	Hay River	Inuvik	Cambridge	Rankin	Baffin
Revenues:						
Market Value	$71,731	$44,671	$27,084	$18,365	$15,156	$32,811
Deposit/Returns	0	0	0	0	0	0
Total Revenues	$71,731	$44,671	$27,084	$18,365	$15,156	$32,811
Expenses:						
L.T. Debt	S16,177	$8,880	$8,880	$8,880	$8,880	$8,880
Wages 1 -F.T. Operator	30,000	30,000	30,000	30,000	30,000	30,000
Wages 1 -P.T. Secretary	10,000	14,400	14,400	14,400	14,400	14,400
O & M (5 - 7% Cap)	5,000	4,378	4,378	4,378	4,378	4,378
BuildingRent and Utilities	7,500	25,500	25,500	25,500	25,500	25,500
Sub Total	$68,677	$83,158	$83,158	$83,158	$83,158	$83,158
15-20% Cont.	7,875	14,855	14,855	14,855	14,855	14,855
Transportation	75,284	38,090	52,290	71,082	73,260	151,668
Tot. Expenses	$151,836	136,103	150,303	169,095	171,273	249,681
Surplus <Deficit>	<$80,105>	<$91,432>	<$123,219>	<150,730>	<$156,117>	<216,870>

Please note that the cost of transportation and building rental are high and extremely variable.

Elimination of transportation costs alone would change the profit and loss statement thus:

Profit < Deficit>	<$4,821>	<$53,342>	<$70,929>	<79,648>	< $.82,857>	<65,202>

A further reduction in the cost of building rental and utilities should the business have its own building, could be realized. The cost of utilities could be held at less than $7,500. The subsequent profit and loss would appear as:

Profit < Deficit>	<$4,821>	<$35,342>	<$52,929>	<61,648>	<$64,857>	<47,202>

Profit and Loss Statement DropOff Depots:
(High Capital/Operating)

Here we will assume that a return or deposit system for all beverage containers exists. The resulting profit and loss statement reflects the increase in revenues.

*** If transportation and rent costs can be eliminated, even the less attractive communities (Regions) are marginally viable.**

Revenues

	Yellowknife	Hay River	Inuvik	Cambridge	Rankin	Baffin
Total	**$143,755**	**$87,743**	**$60,009**	**$S3,348**	**$43,078**	**$89,401**

Expenses

Total Exp.	$151,836	$136,103	$150,303	$169,095	$171,273	**$249,681**

Adjusted Expenses(Less transportation, and holding rent and utilities down under $7,500. per year.)

Adjusted Expenses	**$76,552.**	$80,013.	$80,013$_0$	$80,013.	$80,013.	$80,013
<Deficit > Surplus	**$67,203.**	**$7,730.**	**<$20,004. >**	**<$26,665. >**	**<$36,935. >**	**$9,388.**

- **Eg. Rankin: Purchasing a "park-all" to house equipment, and purchasing/renting containers to store waste after processing along with tax receipts in lieu of cash for freight would allow Rankin** to **approach viability.**

CONCLUSIONS:

1. Transportation costs to market very high!

2. Building rent and cost of utilities very high and variable!

3. Recycling of six identified categories is not viable at this time assuming costs of transportation, rent, and utilities are born by business! Note: Here, a non-profit organization able to eliminate transportation costs by issuing tax receipts in lieu of cash to transport companies would make the business viable in most regions. Note:The purchase of a warehouse outright would also help to cut down the cost of rental and utilities, and in some communities should be considered as an alternative to renting,

4. Deposit/returns coupled with handling fees on all beverage containers has a significant impact on the success of recycling of containers, making it feasible in most regions. An increase of% recovery rate for drop-off depots (of just 5% across the board) would have a significant impact on the economics of recycling.

IMPLEMENTATION STRATEGY FOR RECYCLING THROUGHOUT THE N.W.T.

1. Recycling in its first phase should be implemented in the area serviced by road to Alberta. ie. Hay River- Fort Smith followed by Inuvik, Iqaluit, Cambridge Bay and Rankin Inlet.

2. Expanding to the other regions should begin with those regions already considering recycling as an option. Once Yellowknife is up and running, focus should shift to Hay River-Fort Smith, followed by Inuvik, Iqaluit, Cambridge bay and Rankin Inlet.

3. It is theoretically possible to target one region per year beginning with Hay River-Fort Smith for the year 1990-91 and one additional region per year thereafter.

STEPS TO FOLLOW

1. Establish recycling working committee
2. Solicit support from private and public sector
3. Identify funds for capital and O & M costs.

MATERIALS DISPOSED OF AND THEORETICALLY RECOVERABLE (IN METRIC TONS)

MATERIAL	YK	FT. SMITH	INUV.	KITIK.	KEEWAT.	BAFFIN	TOTALS	VALUE $/M.TON	%RECOV DROP-OFF	% RECW CURESIDE
NEWSPRINT										
DISPOSED	488	32	21	11	14	29	595			
RECOV 70%	342	22	15	8	10	20	417	$10.00	0.4	0.8
OFFICE PAPERS										
STANDARD PAPER										
DISPOSED	2S8	225	120	108	75	164	950			
RECOV 75X	194	169	90	81	56	123	713	$60.00	0.5	0.5
FINE PAPER(1)										
DISPOSED	258	225	120	108	75	164	950			
RECOV 75%	194	169	w	81	56	123	713	$100.00	0.5	0.5
CARDBOARD										
DISPOSED	1741	1415	992	508	666	1331	6653			
RECOV 70%	1219	991	694	355	466	932	4657	$45.00	0.12	0.25
MIXED METALS										
DISPOSED	338	296	193	100	131	262	1320			
RECOV 50%	169	148	97	50	66	131	661	S35.DO	0.06	0.12
ALUMINIUM CANS										
DISPOSED	123	56	37	19	19	40	294			
RECOV 90%	111	50	33	17	17	36	264	$1,200.00	0.3	0.65
GLASS CONTAINERS(2)										
DISPOSED	274	261	126	143	44	132	980			
RECW 90%	247	235	113	129	40	119	883	S77.DO	0.3	0.65
MIXED PLASTICS										
DISPOSED	1049	994	649	336	441	880	4349			
RECW 25%	262	249	162	84	110	220	1087	$66.00	0.12	0.25
P.E.T.										
DISPOSED	6	5	3	2	2	4	22			
RECW 90%	5	5	3	2	2	4	21	Silo.oo	0.3	0.65
DROP-OFF S	$71,731	S44,671	S27,084	S18,365	S15,156	S32,811	$209,818			
CURBSIDE S	S136,302	S80,694	%9,818	$31,993	S27,300	S58,987	$385,095			

1- FINE PAPER IS 50% OF TOTAL OFFICE PAPER GENERATED.
2- GLASS CONTAINERS HERE REFERS ONLY TO THE BEVERAGE CONTAINERS AVAILABLE FOR RECYCLING. SEE TABLE 2.4.1

APPENDIX C

Partial list of

Recycling Equipment

Manufacturers

&

Secondary Materials Markets

MARKETS FOR RECYCLABLE MATERIALS

(Partial Listing Only)

Paper **Products:**

Paperboard Industries Corporation
2015-87 Avenue, Sherwood Park
Edmonton, Alberta
T6P 1L5
(403) 464-4761

Allied Paper Savers
16345-130 Avenue
Edmonton, Alberta
T5V 1 K5
(403) 447-1648

Metals:

Stelco Steel **(ferrous only)**
P.O.Box 2348
Edmonton, Alberta
T5J 2R3
(403) 468-7301

Pacific Metals Ltd.
8360 Ontario Street
Vancouver, B.C.
V5X 3E5
(604) 327-1148

Calgary Metals
3415 Ogden Road, S.E.
Calgary, Alberta
(403) 262-4542

Western Canada Steel **(ferrous only)**
2601.52 **Street,** S.E.
Calgary, Alberta
T2B 1N3
(403) 272-4056

Canadian Consolidated Slavage
10419- 96 Street
Edmonton, Alberta
(403) 424-0770

Shred-A-Can Recyclers Ltd.
#248, 2880 Glenmore Trail, S.E.
Calgary, Alberta
T2C 2E6
(403) 279-2724

Glass:

Consumer's Glass
Vernon, B.C.

Canasphere Industries Ltd.
3344-58 Avenue, S.E.
Calgary, Alberta
T2C 0B3
(403) 279-2296

Plastics:

Currently no markets for mixed plastics in Alberta.

Certain types of clean, sorted scrap plastics accepted by:

Polymont Plastics Corp.
4746 Riverside Drive
Red Deer, Alberta
T4N 2N7
(403) 342-1977

Wild Rose Plastics
5529-103 Street
Edmonton, Alberta
(403) 437-1708

Dow Chemical Canada Inc.
Sarnia, Ontario
Contact: Mr. Geoff Rathbone
(406) 232-8848

In addition to the above, the Plastic Bottle Institute publishes "Plastics Recycling Directories", which may be obtained by writing to:

Plastic bottle Institute
1275 K Street, N. W., Suite 400
Washington D. C., 20005
U.S.A.

SUPPLIERS OF RECYCLING EQUIPMENT

Complete listings can be found in North American WAste Managemet Magazines, such as:

Waste Age, July 1989 Issue, "Equipment **for Recyclable Collection"**

The Management of World Wastes, July, 1989 issue, "16th Annual Buyers Guide"

A few randomly selected companies specializing in recycling equipment are presented below:

Can Densifiers, **Glass Crushers:**

CP Manufacturing Inc.
1428 McKinley Avenue
National City, California 92050
(619) 477-3175

Balers:

Kilkom Inc.
Building 13, Spokane Industrial Park
Spokane, Wa. 99216
U.S.A.
(509) 928-5252

Balemaster
980 Crown Court
P.O. Box 465
Crown Point, Indiana 46307
U.S.A.
(21 9) 663-4525

Economy Baler Division
The American Baler Company
Hickory Street
Bellevue, Ohio 44811
U.S.A.
(41 9) 483-5790

Cram-A-Lot
J.V. Manufacturing Inc.
303 Highway 265 Spur
P.O. Box 229
Springdale, AR 72765
U.S.A.
(501) 751-7320

Selco Products Inc.
P.O. Box 406
Baxley, GA 3513
U.S.A.

Conveyors:

Mayfran International
P.O. Box 43038
Cleveland, OH 44 I 43
U.S.A.
(216) 461-4100

MARKETS FOR RECYCLABLE MATERIALS

(Partial Listing Only)

Paper Products:

Paperboard Industries Corporation
2015-87 Avenue, Sherwood Park
Edmonton, Alberta
T6P 1 L5
(403) 464-4761

Allied Paper Savers
16345-130 Avenue
Edmonton, Alberta
T5V 1 KS
(403) 447-1648

Metals:

Stelco Steel **(ferrous only)**
P.O.Box 2348
Edmonton, Alberta
T5J 2R3
(403) 468-7301

Pacific Metals Ltd.
8360 Ontario Street
Vancouver, B.C.
V5X 3E5
(604) 327-1148

Calgary Metals
3415 Ogden Road, S.E.
Calgary, **Alberta**
(403) 262-4542

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2601**.52 Street,** S.E.
Calgary, Alberta
T2B 1N3
(403) 272-4056

Canadian Consolidated Slavage
10419-96 Street
Edmonton, Alberta
(403) 424-0770

Shred-A-Can Recyclers Ltd.
#248, 2880 Glenmore Trail, S.E.
Calgary, Alberta
T2C 2E6
(403) 279-2724

Glass:

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Vernon, B.C.

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A few randomly selected companies specializing in recycling equipment are presented below

Can Densifiers, Glass Crushers:

CP Manufacturing Inc.
1428 McKinley Avenue
National City, California 92050
(619) 477-3175

Balers:

Kilkom Inc.
Building 13, Spokane Industrial Park
Spokane, Wa. 99216
U.S.A.
(509) 928-5252

Balemaster
980 Crown Court
P.O. Box 465
Crown Point, Indiana 46307
U.S.A.
(219) 663-4525

Economy Baler Division
The American Baler Company
Hickory Street
Bellevue, Ohio 44811
U.S.A.
(41 9) 483-5790

Cram-A-Lot
J.V. Manufacturing Inc.
303 Highway 265 Spur
P.O. Box 229
Springdale, AR 72765
U.S.A.
(501) 751-7320

Selco Products Inc.
P.O. Box 406
Baxley, GA 3513
U.S.A.

Conveyors:

Mayfran International
P.O. Box 43038
Cleveland, OH 44143
U.S.A.
(216) 461-4100