The Corporation of the
City of Burlington

Halton Landfill Environmental Assessment

Waste Generation Report

851005

March 1988

STAMM ECONOMIC RESEARCH

187 King Street East
Toronto, Ontario
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PART ONE

INTRODUCTION

1.1 Introduction

This report has been prepared by this firm to examine the matter of waste management landfill site selection for the Region of Halton. It reviews the methods of estimating the annual level of waste generation and examines the implications for the waste quantities projected for Halton Region by C. N. Watson and Associates Ltd. (Watson) in the report entitled "EPA Review of Waste Quantities Projection" (Watson EPA Review report, Exhibit H-15).

Beyond this introduction there are three main parts to the report:

1. Part Two is an overall review of the economics of waste generation, with respect to both residential and non-residential waste generation. This part lays out the fundamentals of "waste generation" in the overall economic process, i.e., it creates an informal "economic model" that assists in understanding the factors that determine the level of waste which would be generated.

   Part Two also provides a review of waste generation literature with a view to determining such quantitative relationships as exist between levels of economic activity and waste generation. While the data is not sufficiently complete to permit the construction of a complete model, it is sufficiently complete to document some important relationships.

2. Part Three provides comparisons of waste generation rates between different municipalities and over time. Past trends in waste generation, when related to economic phenomena are significant in establishing possible future patterns.

3. Part Four considers different projections of waste generation rates and assessed the impact on the total waste quantities which can be projected for Halton Region.

many repects the analysis of future consumption waste generation must start with the study of future consumption in the same manner as is done for shopping centre studies.

From Figure 2.1 the factors that are "variable" and the process of calculation can now be constructed. In so doing, it can be observed that consumption generated waste (such as that from lunches at or near the location of employment) can be included as production related waste.

For purposes of municipal waste management programs, which require detailed knowledge of waste collection by routes, it is desirable to break down the waste generation by "land use". From it it is possible to develop better, more specific estimates of generation, and assess the possibility of effective recycling programs.

2.4 Household Consumption Solid Waste

Consumption solid waste is waste generated by households at the location of the household. Generally, municipal authorities are responsible for the collection of these wastes although some large apartment buildings have private companies collecting the wastes separately.

The main points with respect to this form of waste are as follows:

1. A key component of household solid waste is the post-consumer solid waste. Post-consumer waste consists of (i) refuse from the good itself such as worn clothes or food residuals, and (ii) packaging material that came with the good. As such, post-consumer solid waste is both a function of different consumption habits and technological changes within the packaging industry (Bonus & Hastings).

2. Household consumption habits are dependent on a whole range of household characteristics. Among them are:

   a) household income,

   b) ethnicity,

   c) household size,

   d) age of household members,

   e) housing form, and,

f) other socio-economic variables such as education.

3. Higher household income leads to consumption of more goods and services. This influences the waste generation of a household in a number of ways (Tolley, Havlicek Jr., & Fabian):

a) "The quantitative effect of income on wastes depends in part on the relative importance of material inputs to human inputs in the increased consumption. To the extent that additional goods and services are produced by human effort, the generation of additional waste will be reduced. High income elasticities of demand for health and other professional care, for entertainment, and for other services - all of which are relatively labor intensive - suggest that this dampening effect is significant." (p.7)

b) Higher income shortens the lifespan of consumer items. Clothes and other durable goods such as television sets are disposed of earlier than otherwise. Leftover foods are discarded instead of being saved for later meals (p.7). (The manner in which unwanted goods are disposed would have an impact on waste output. Giving used clothing to Goodwill instead throwing them out into the garbage directly would delay the immediate rise in the level of waste output.)

c) Overall, the rising importance of leisure lessens the likelihood of salvaging goods for later use (p.8).

4. Empirical studies of household solid wastes generated in different neighbourhoods suggest that income level is the most significant factor in explaining variations in waste generation rates (Rudzitis & Bonus). A positive relationship exists between income levels and rates of waste generation (Havlicek, Richardson & Saleh). Because of the dampening effect of increased services versus goods consumptions as income rises, a 10 percent increase in income will have a less than 10 percent increase in solid waste output. The best evidence suggests that the income elasticity averages close to .50 percent over the course of a year. Thus, household consumption waste grows at about 50% of the rate of increase in income (all other things being equal).

5. Given that household generated wastes are mainly post-consumer solid waste, waste generation rates will fluctuate with the economic cycle. During the recession of 1982-1984, a downward trend in the waste generation can

be observed. Similarly, waste output will rise in times of economic prosperity.

6. Consumer habits have a major impact on waste generation. This is best demonstrated by the disposable diaper, which generated a significantly greater volume of waste than that produced prior to its introduction. The use of refundable bottles and cans for beer and other beverages resulted in a reduction in the amount of refuse output from households. These consumer habits are formed in largest part by the manipulation of the price structure of consumer items.

7. Technological changes have also proven to be significant. The trend in using lighter packaging material such as plastic and foam has reduced the tonnage of waste produced. The development and ownership of alternative disposal facilities such as sink disposals and devices like home freezers for the conservation of leftovers also affect the quantity of waste produced in a household as well (Bonus & Hastings).

8. Quite aside from the matter of household structure and form, the type of housing affects the waste generated by the household. Households in grade access homes with larger lot sizes generate yard waste while similar waste produced per apartment unit is much less.

9. Separation at source programs to reduce waste involve a relatively minor effort by the householder yet the effort is sufficient to create "value" to the materials being collected. Once separated they are often recycled, i.e., used as an input resource. To the extent that municipal "source-separation" programmes are successful, a portion of the total waste stream is discounted. (In Halton Region, a comprehensive source separation program is in place. As referenced in the Region's Report entitled "EPA Review of Waste Quantities Projection" (Exhibit H-15), source separation accounts for 4.6% of the total waste stream in 1985 (p.12)). The most significant finding from the literature is the probability that the **frequency** of the collection service for segregated post consumption products such as newspaper is a significant determinant in the willingness of the households to reduce waste by source separation.

10. Limited but useful evidence shows from a very small Toronto sample of waste by land use that paper and related products form on the order of 40% of the households waste while food waste acccounts for on the order of 20%. Glass contributes another 7%, metals a further 6%. The remainder is com-

prised of textiles, plastic, wood product waste and other combustibles and non-combustibles.

It is possible to construct a detailed formulation which then relates the household consumption waste generated to the socio-economic and housing characteristics of the particular community based households. Such studies have been undertaken, although not for the Region of Halton.

To conclude, household waste generation is influenced by many factors. Among them, the level of household income appears to have major impact on waste output.

- A thorough projection of consumption waste, attributable to the household at the location of residence must take all of the above factors into account. As the long-term trend for real Personal Disposable Income is expected to rise, a higher level of consumption would imply an increased rate of waste generated per capita.

Real Personal Disposable Income per capita in Ontario has been rising steadily. From 1971 to 1986, real growth has been increasing at a compounded average rate of 2.56% annually (see Figure 2.2).

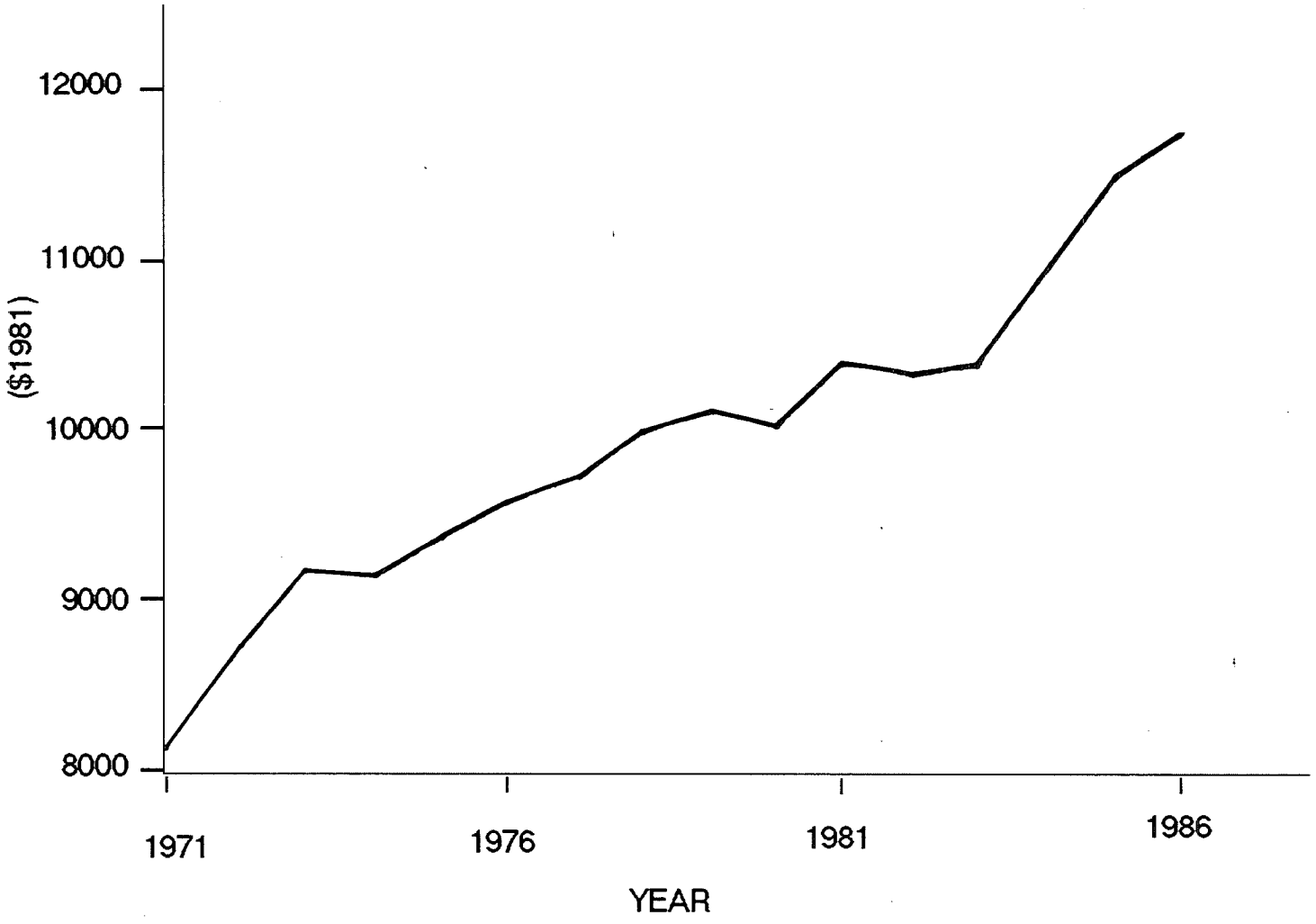
2.5 Non-Residential Waste

Non-residential waste is somewhat more difficult to deal with because of the high variation, and the many different sets of circumstances. Up to this point there is very little "hard" information which properly relates the level of economic activity by land use type with the amount of waste being generated. The data is, in general, available only on the basis of transported weight of waste related back to the level of employment generally associated with the employment sectors from which the waste was collected. That does not permit the segregation of waste by specific land use type, and the determination of the waste production rates. Nevertheless, it is useful to view it in that manner.

Commercial solid waste generated by businesses can be broken down into four broad categories: (i) office type activities and (ii) retail type activities other than restaurants and food service, and (iii) restaurants and other food service, (iv) construction waste. Office waste is, for the most part paper product, (on the order of 95%) including both the actual paper product used in the office and packaging products. Retail activities generate substantial packaging waste directly at the location of retailing activity, about 75% of the total in paper and related products and 10% of the total in waste plastic. The remaining 15% is distributed amongst other forms.

FIGURE 2.2

REAL PERSONAL DISPOSABLE INCOME IN ONTARIO
1971 – 1986



Restaurant and food service food waste by-product is often recycled for non-human consumption depending upon the volumes produced by the establishment. Limited data suggests that on the order of 40% to 45% of total waste is food waste. The other major element of waste is typical packaging waste comprising approximately 50%. (Glass products such as liquor bottles are in many cases separated at source.) Construction waste forms a significant flow of material waste, incorporating all non-salvageable categories from carpet remnants and adhesive chemicals to metal, wood, glass, wallboard remnants, and so forth.

The primary activities, i.e., agrictulture, mining, fishing and forestry, and the secondary manufacturing sector also produce waste, but the manner of disposition is often internal. The urban communities are involved to a significant extent only in the primary and secondary manufacturing process. Manufacturing processes tend to use all possible means to prevent "waste" because of the direct costs associated with the disposal costs. (Such costs are directly reflected on balance sheets.)

Finally, institutional activities such as education, and health care also generate waste on a significant scale.

While some commercial waste may be collected municipally, most is collected by private haulers. In general, shopping centres and large office buildings have contracts with private waste disposal companies to haul their waste.

2.6 Some Conclusions

Pertaining to the matter in the Region of Halton, a number of major points guiding the projection of waste generation can be outlined.

1. The level of waste generation from a given community is strongly related to the scale and character of the local economy as it affects both the consumption of goods and services and the production of goods and services. With respect to consumption the level of economic activity as measured by the (a) the level of "Personal Disposable Income", and (b) the consequent level of "Personal Expenditures on Consumer Goods and Services", (from the national accounts data) would be the starting point, with the recognition that the increases in waste generation rates are proportionately lower than the increase in income. With respect to non-household waste, the levels are related to the specific economic profile of the local production sector, particularly goods production, and growth in those activities. In times of

economic downturns, as sales in shopping centres and business in restaurants decline, the amount of waste generated would drop as well.

2. Solid waste generated in the non-household sector can be employment-related in aggregate. The higher the employment level in an urban centre, the higher the expected level of commercial waste. In addition, services such as restaurants and shopping centres located in these centres would be providing services to both residents and employees in the area. Hence, waste output would be higher than the peripheral areas. (This is the so-called "centre-periphery" effect.)

3. Halton Region has become more self-contained in recent years. Commercial centres in both the City of Burlington and Town of Oakville are experiencing expansions and redevelopment **and displacing the shopping trip to Mississauga or Hamilton.** As these communities grow, additional institutions will have to be provided, internalizing the use of facilities (such as hospitals and educational institutions) outside the communities. Hence, as an area becomes more self-contained with respect to the full range of urban services, its waste generation level will rise disproportionately to reflect that fact.

4. In the abscence of a thorough base on which to make projections, the trend would most certainly be for municipal waste per capita to increase significantly.

PART THREE

REVIEW OF AVAILABLE DATA ON

WASTE GENERATION RATES AND TRENDS

3.1 Introduction

As is evident from Part 2, the quantity of waste generated is functionally dependent on many individual factors.

- Pertaining to the present matter, the objective is to establish with some considerable certainty the quantity of waste that will be generated.

The Region of Halton has not developed projections which provide the likely economic profile and land use profile which will exist at various times over the next three decades. The Region has also not accounted for the waste being generated by source of origin in a manner which permits data based analysis.

Consequently it is not possible to make projections with a documented knowledge base of waste generation in the Region of Halton.

- The only guidance available is the measurement of the quantity received at the current landfill sites, as compared with the population of the Region. This provides significant error potential from three sources:

  a) First, the landfill may include waste materials which come from sources outside the Region.

  b) Second, there may well be significant flows of waste to destinations outside the Region (dependent on the relative tipping fees and transportation costs).

  c) Third, the amounts would not account for the incidence of illegal dumping of waste, on which subject little is known. As with air and water pollution control, which has become more regulated in the last three decades, similar measures will likely be developed for solid waste which might increase the total amount to be landfilled.

One method of supplementing this lack of data is to draw comparisons with other Ontario communities for which data does exist. This "comparative" method permits an evaluation of the sparse information for the Region of Halton against other comparable situations.

3.2 A Note on Data Sources

Generally, it is very difficult to get measurements of waste generation for the different sectors separately. Statistics on waste hauled by municipalities versus private haulers are in some cases available, but since they both provide services to the residential and commercial sectors, it would be difficult to arrive at an estimate. Moreover,measurements of waste generation are subject to definitions which are not always consistent. Some measurements include construction and demolition waste, yard waste, and abandoned cars and trucks. Others measurements exclude these items.

For this project the firm of Conestoga-Rovers & Associates Limited (CRA) have compiled available data for Ontario municipalities.

3.3 General Statistics: Region of Halton

Table 3.1 summarizes the per capita waste rates for Halton Region from1976 to 1986. From this data a number of observations can be drawn.

1. Waste **collections** per capita, prior to source separation has been estimated at .874 tons (.795 tonnes) per capita for 1986.

2. The comparable figure for 1976 was .818 tons (.743 tonnes) per capita. Subject to the accuracy of the data, and using only those end points, the growth rate of waste per capita can be calculated at .7% per year.

3. Waste collection rates fluctuate quite significantly between different years, although with the "open" nature of the system, the variation may be due in part to cross border shifts.

4. The recession of the early 1980's had a demonstrable effect on the quantity of waste landfilled, suggesting that the reductions in household consumption and activity rates are being reflected rapidly in reductions in waste generated.

TABLE 3.1

ANNUAL PER CAPITA WASTE GENERATION RATES IN HALTON REGION

Year	Halton Region Waste per Capita in Tons	Halton Region Waste per Capita Excluding Source Separation
1986	.874	.834
1985	.832	.796
1984	.787	.759
1983	.715	.700
1982	.818	.807
1981	.821	.821
1980	.815	.815
1979	.834	.834
1978	.815	.815
1977	.824	.824
1976	.818	.818

Source: i. C.N. Watson for 1976-1985 data.
ii. Region of Halton for 1986 data.

5. For Halton Region, per capita waste has been reduced through the source separation program.

6. Because tipping fees are higher in Halton Region than the adjacent areas, this is an incentive for private haulers to dump waste outside the Region and will result in a lower per capita waste rate for Halton.

3.4 Comparative Statistics: Other Regions

Other data of waste disposal quantities across Ontario and other municipalities is available from numerous sources, most of them are usually engineering studies.

- The information from these studies is difficult to interpret with great accuracy for the reasons noted in Part 2. The biggest problems are: 1) often the data ignored the waste that are disposed through services other than municipal services, and 2) the definitions of waste are different. Nevertheless, the information has considerable value, although it should be reviewed with care.

The data is generally of two types. First, some estimates are provided of the **quantum** of waste generated (measured usually from the collection process), in various municiaplities in individual years. That established the range of quantities either per capita or per employee which can reasonably be applied to the circumstances that prevail, or will prevail in the Region of Halton. A comparison can then be made against the quantum (per capita) used in the Watson report. Second, the **growth rate** of waste generation can be examined from comparable municipalities. That provides a range of findings with respect to growth in a broader "sample" of cases than just the Region of Halton, and permits some testing of the matter of growth of waste generation compared with growth of per capita income.

Table 3.2 shows comparable statistics for a number of municipalities:for the most recent years available in each case. This information is therefore "cross-sectional". Because the data is not based on the same year the comparison must not be used to establish a relationship between the size of the municipal population and the waste per capita.

1. Metropolitan Toronto, rates are at 1.25 tons (1985) per capita.

2. Those of the Region of Peel are 1.16 tons per capita (1986). Separately, those for the City of Mississauga are 1.25 tons, while those for Brampton are .96 tons.

TABLE 3.2

PER CAPITA WASTE GENERATION RATES: OTHER REGIONS

Area	Waste per Capita (tons/capita)	Year
Chatham	.821 (i)	1975
Hanover/ Walkerton	1.095 (ii)	1976
Region of York	.835 (iii)	1979
Woodstock	.922 (iv)	1971
Ingersoll	.918 (iv)	1971
Region of Peel	1.151 (v)	1985
Metro Toronto	1.25* (v)	1985
Edmonton	.94** (v)	1985
Calgary	1.04** (v)	1985
Red Deer	.82** (v)	1985
Region of Waterloo	.93 (vi)	1982

* may include some wastes from outside Metro

** exclude construction and demolition rubble

Source:

i) M.M. Dillion (1975)
ii) Ontario Ministry of Environment (1976)
iii) Gore and Storrie (1981)
(iv) Turnbull (1973)
(v) MacLaren Plansearch (1986)
(vi) MacLaren Engineers (1984)

3. Information for York Region is .83 tons per capita (1979).

4. Estimates for Calgary and Edmonton for 1984, **which exclude construction and demolition waste** are running at 1.04 tons and .94 tons per capita; while those of Red Deer are at .82 tons.

5. The Region of Waterloo, with its considerable rural population showed rates of .93 tons (1982). Indvidually, the urban municipalities showed much higher rates, at 1.34 tons for the City of Cambridge, 1.35 tons for both the City of Kitchener, and the City of Waterloo.

It is important to recognize that the rate of waste generation which is registered as collected and disposed of by both municipal and private operators are very different in rural and smaller urban areas as compared with larger urban areas. Each of the above cases, with the exception of Metropolitan Toronto has some rural population. (The low figure for the Region of York may be to a considerable extent the outcome of having a much higher "rural" population.)

For purposes of analysis it may be deemed a reasonable assumption that the waste generation rates of Oakville and Burlington are very close to those of Brampton, Cambridge, Kitchener and City of Waterloo, at .96 tons, 1.34, 1.35 tons, and 1.35 tons respectively. To examine the possibilities, a rate of 1.15 tons per capita will be **assumed** for the analysis below. Since the "rural" rates are known to be lower, a rate of only .5 tons per capita has been **assumed** for Milton and Halton Hills even though these municipalities are predominantly urban. (It is very unlikely that the rates are actually that low.)

- Using the basis of only 1.15 tons per capita for Oakville and Burlington, and .5 tons per capita for Milton and Halton Hills, then the total waste generated for 1986 would have been 268,000 tons, or almost exactly 1.0 tons per capita (see Table 3.3). **Since the measurement as reported, is only 215,746 tons (including the separated waste), the difference as reported is on the order of 52,000 tons.**

Even using 1.0 tons per capita for Oakville and Burlington, -- a full 26% below the Kitchener, Waterloo, Cambridge rates --, the total waste generated would have come in at 237,583 tons, or 12,237 tons higher than the reported measure.

The major conclusion to be arrived at from this comparative analysis is as follows:

- In application to the Region of Halton, these figures would suggest strongly that the waste, estimates used for the Region of Halton, at .874 tons/capita before source separation, or .834

TABLE 3.3

WASTE GENERATION FOR HALTON: 1986

Scenario 1:

Burlington	116,673 x 1.15	= 134,174
Oakville	87,107 x 1.15	= 100,173
Milton	32,037 x 0.5	= 16,018
Halton Hills	35,570 x 0.5	= 17,785
Total for Halton Region		**268,150**

Scenario 2:

Burlington	116,673 x 1.0	= 116,673
Oakville	87,107 x 1.0	= 87,107
Milton	32,037 x 0.5	= 16,018
Halton Hills	35,570 x 0.5	= 17,785
Total for Halton Region		**237,583**

tons/capita after source separation are extremely low. It would appear necessary to (i) verify the measurement and ascertain that no waste is being shipped out of the Region; (ii) and/or explain the differences on the basis of differences in economic profile, (iii) provide some assurance that, if the information is to be used for projections, the unique circumstances of "low waste generation economic profile" will remain unchanged.

For this report these matters were briefly examined.

In comparison to the City of Brampton, the Town of Oakville and the City of Burlington would appear to have equivalent or greater waste generation profiles.

1. Taking downtown Brampton and Bramalea City Centre, a total of 361,562 sq. ft. is found in 1986. The total for Oakville was 466,500 sq. ft. (These figures are based on Royal LePage's Toronto Office Leasing Directory). The City of Burlington claims 1,375,077 sq. ft. of office space in March 1986. Thus Burlington and Oakville are certainly much higher in terms of office waste generation.

2. In the industrial sectors the entire QEW corridor with extensive industry exceeds in total occupied industrial acreage the level of Brampton on a per capita basis. Unfortunately the employment data is not sufficiently reliable for valid comparison, and the "industrial profile" differences are not available.

3. With respect to commerical retail activity, the City of Burlington, and the Town of Oakville are equivalent in terms of per capita space to Brampton.

4. With respect to residential waste, **the substantially higher levels of income in Oakville and Burlington, compared to Brampton** would suggest higher rates of waste generation.

There is **prima facie** no basis for the presumption that the waste generation rates are lower for Burlington and Oakville than they are forBrampton.

Similar comparisons for the Kitchener, Waterloo and Cambridge municipalities suggests that these are somewhat more self-contained with respect to urban functions, leading to higher waste generation rates for these municipalties. However, this is offset, at least in part, against the fact that they enjoy a lower per capita income standard.

Table 3.4

COMPARISON OF WASTE GROWTH RATES

Tons per Capital

	Brampton	Mississauga	Caledon	Metro Toronto
1976				0.88
1977				0.91
1978				0.90
1979				0.89
1980	0.99	1.13	0.54	0.95
1981	0.92	1.21	0.58	0.96
1982	0.88	1.11	0.52	0.92
1983	0.93	1.13	0.79	0.93
1984	1.00	1.21	0.97	1.04
1985	0.97	1.25	1.07	1.25

Note: Data for Metro might include some wastes from outside the municipality.

Source: MacLaren Plansearch (1986)

In considering the use of the "current" waste generation rates for purposes of the future, there must be the assurance that the rates will not rise for "structural" (as opposed to income) reasons. Clearly the data for Metropolitan Toronto and the City of Mississauga (as well as that for Kitchener, Waterloo and Cambridge) shows the effect on waste generation of a more "self-contained" set of functions. In essence the "centre-periphery" effect vanishes with development of more functions in the outlying areas.

- There is every reason to expect that the City of Burlington and the Town of Oakville will undergo the experience that has accrued to the City of Mississauga as it went through the same transitions. **This points most strongly to the need to increase the rates of waste generation for the future for the Region of Halton.**

3.5 Comparable Growth Rates

Table 3.4 summarized the most applicable information available with respect to actual growth rates experienced. The data with respect to growth of waste generation is very limited. Five cases have been analysed: (i) Metropolitan Toronto, (ii) the City of Brampton, (iii)the City of Mississauga, (iv) the Town of Caledon, (v) the municipal component of the City of Hamilton.

In each case the growth rates from the first year to the last year shown has been calculated into an "annual average" growth rate. It is worthy of note that some of the data coincides with high rates of more recent economic resurgence.

1. For Metropolitan Toronto the waste growth shows an annual average growth rate of 3.9% per year from 1976 to 1985.

2. For the City of Brampton there was no growth in total waste per capita. However, a close examination showed that the household waste did show growth of 1.3% per year, indicating that the employment-related waste declined per employee, (or that the employment estimate used by MacLaren Plansearch was in error).

3. For the City of Mississauga the rate of increase of total waste per capita was 2.1% per year for the same period. Household waste grew at 1.5% per year per capita.

4. The experience of the Town of Caledon, with a rate of increase of 14.6% per year over the same period is somewhat unique. The high rates of growth in the residential sector suggest that waste formerly disposed of privately has

been diverted to landfill sites at which the waste is counted. (The residential generation has gone up from .44 tons per capita to .79 tons per capita in just five years.)

5. Some data is also available for the City of Hamilton, and the Region of Hamilton-Wentworth. but the data must be used with qualifications. The data included is only the waste handled by the municipal waste collection service and therefore is not a complete accounting. Any shifting from private to public service, or vice versa would affect the results. Assuming that these changes were not significant, the rate of increase can be calculated. Proctor and Redfern calculating for 1962 to 1971 noted a rate of increase in household waste at 1.8% per year. Subsequent data for the Region including all municipally handled waste showed a growth rate of 2.0% per capita.

3.6 Conclusions

From the results of Sections 3.4 and 3.5 it is apparent that:

- The use by the Watson Report of .832 tons per capita (before separation) as a waste generation rate, and the projection of no growth in the level of waste generation per capita significantly understates the likely quantity of waste which will require waste management over the short and longer term future.

In Part 4, alternative projections of total waste production for the Region of Halton have been calculated.

PART FOUR

REALISTIC PROJECTIONS OF PER CAPITA WASTE

4.1 Introduction

In this section of the report, we will examine the likely range of waste generation projections for Halton Region using the information as outlined in Part 3.

4.2 Constructing a Range of Projections

There are three fundamental considerations which should guide the construction of waste generation projections.

1. In the absence of complete projections showing the economic profile of the municipalities which comprise Halton Region, the future generation of waste can be related generally to the level of population. (It is beyond the scope of this project to attempt a superior method).

2. The level of waste per capita should be set, both at the start of the projection period and over future years to reflect the expected changes in the economic profile or the "centre-periphery effect". This would constitute a growth of waste per capita unrelated to either household consumption increases per capita, or waste per employee.

3. Finally a rate of increase in the total waste per capita should reflect the increase which would be brought about by consumption increases based on income increases, (unless a strong case can be made for a lack of growth in per capita income); and the likelihood of some waste increase per employee from the production process.

Based on the information presented in Part 3, a range has been established for both low and high estimates. The following reasons went into the range as set forth.

1. A basic level of .9 tons per capita has been used as a starting point for 1988. Based on the economic performance of the entire Toronto Region, and

the high growth of per capita income, those rates are likely for 1988. It also reflects an upward bias to the possibility that the collection data undercounts the actual generation rates. The starting point is 10% below the Brampton level, 23% below the Mississauga level, and 28% below the Metropolitan Toronto level, as well as 33.3% below the levels of Kitchener, Waterloo, and Cambridge. The level may be well below the true actual.

2. In recognition of the centre-periphery effect, a conservative rate of increase over the next 10 years adding .01 ton per capita has been factored in. That represents the addition of 20 lbs. per person per year on a base of 1,800 lbs., and would bring the base rate to 1.0 ton per person per year by the year 1998. That would still be a very low rate at that time.

3. In recognition of the continued increase in the level of increase in consumption and employment productivity, an additional rate of increase ranging from .5% to 1.0% per year is likely. This range is consistent with the income increase rates which can be foreseen. **It presumes that the recent increases, consistent with the economic resurgence of the 1980's will not be achieved over the longer period.**

4.3 The Expected Growth in Waste Generation Per Capita

On the basis of the above considerations, Table 4.1 has been calculated.

The low projection would see the rate of waste generation grow to 1.1 tons per capita be the year 2008, which represents an average annual growth rate (using the end point only) of 1.1% per year. The absolute level of 1.1 tons per year would still be well below the **current** rates of Metropolitan Toronto, Mississauga, the entire Region of Peel, and other noted municipalities.

By contrast, the medium projection brings the per capita rate to 1.16 tons, the current rate of Mississauga, while the high projection takes it to 1.22 tons per capita per year.

- It is the recommendation of this report that the "medium" projection be used. It is a further recommendation of this report that, given the much higher waste generation rates noted for other municipalities, and the possibility of measurement error, a very large contingency allowance be considered.

TABLE 4.1

WASTE GENERATION RATES FOR HALTON REGION 1988-2008
THREE SCENARIOS

Year	Low Tons per Capita	Medium Tons per Capita	High Tons per Capita
1988	.900	.900	.900
1989	.915	.917	.919
1990	.929	.934	.938
1991	.944	.951	.958
1992	.959	.968	.978
1993	.973	.985	.997
1994	.988	1.003	1.018
1995	1.003	1.020	1.038
1996	1.018	1.038	1.058
1997	1.034	1.056	1.079
1998	1.049	1.074	1.100
1999	1.054	1.082	1.111
2000	1.059	1.090	1.122
2001	1.065	1.098	1.133
2002	1.070	1.107	1.144
2003	1.075	1.115	1.156
2004	1.081	1.123	1.167
2005	1.086	1.132	1.179
2006	1.092	1.140	1.191
2007	1.097	1.149	1.203
2008	1.102	1.157	1.215
Average Growth rate	1.01%	1.26%	1.51%

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