Residential GAP – Manual on Generally Accepted Principles (GAP) for Calculating Municipal Solid Waste System Flow

Development of a Methodology for Measurement of Residential Waste Diversion in Canada

November 2003

Release

CSR
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Welcome to the GAP family!

By participating in the GAP process, you join a growing number of Canadian municipalities that are using the Residential GAP protocol to track waste generation and flow. This standardized approach allows you to compare your own performance more accurately from one year to another. As well, for the first time, you will be able to compare your municipality with others across Canada on an "apples-to-apples" basis.

As of November 2003, 54 completed GAP charts from Canadian municipalities and 15 completed GAP charts from UK municipalities are available for viewing on the GAP website (www.csr.org), and we expect the number to grow over time.

MSW GAP and Cost GAP protocols have been developed to allow you to report municipal waste flow and cost data in a standardized format, again with the capacity to share and compare this information.

GAP has been successful because of the involvement of municipalities, federal and provincial government staff and non-government organizations. We continually modify and improve GAP through the feedback from users. We welcome your comments about GAP and invite you to communicate with us at gapinfo@csr.org.

Sincerely

Damian Bassett
President and CEO

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1.0 INTRODUCTION

1.1 Residential GAP

"GAP" refers to Generally Accepted Principles (for municipal waste measurement). The GAP process was initiated in late 1999 to address a need to develop a common reporting framework that could be used by municipalities across Canada to report waste generation, diversion and disposal. At the time GAP was launched, municipalities across Canada did not use a standard approach to measuring solid waste system flow. The need for a common basis of reporting and for a consistent approach to waste measurement had been identified for some time. The benefits which would result from a common approach across the country included:

- Identification of accurate and verifiable waste quantities;
- Comparison of one municipality with another could be carried out on an "apples to apples" basis;
- It would allow comparison of waste management system performance from one year to another;
- It could be used to communicate results of waste diversion programs, and
- It could be used for evaluation of budgets.

A Canada-wide GAP Team was established in late 1999 to examine municipal waste flow and diversion and to identify how to apply a standardized protocol to report waste generation, diversion and disposal in municipalities across the country. The GAP Team included 25 members from municipalities, provinces, NGOs and private sector industry from across the country. Appendix A contains a list of GAP Team members. Appendix B contains the Terms of Reference for the original GAP Team.

The GAP Team completed its initial residential waste flow work in 2000. The Residential GAP Protocol was initially tested in five Canadian communities, and modifications were made as a result of the feedback obtained. The Residential GAP Protocol is currently being used by a number of towns, cities and regions throughout Canada. Efforts are on-going to encourage more municipalities and provinces to adopt the Residential GAP Protocol as a standard reporting methodology.

1.2 MSW GAP and Cost GAP

A follow-on GAP process was launched in spring, 2001 following a request by a number of municipalities to carry out a similar process to Residential GAP Waste Flow for residential waste management costs. The Cost GAP process was originally intended to address residential waste management costs only, but early in the process, the mandate of GAP 2001 Team was expanded to include the measurement of all municipal solid waste, including both residential and non-residential waste. This additional GAP process is referred to as MSW GAP (a protocol to measure all municipal solid waste flow).

Two teams were formed as part of the GAP 2001 process. The Cost GAP Team focused on developing a protocol for reporting residential waste management system costs, so that municipalities across Canada could report and record this information in the same way. The MSW GAP team focused on reporting of all municipal waste flows, including those managed by the municipality, and those generated and managed by the private sector. The MSW GAP and Cost GAP Manuals and example charts can be found on the GAP website www.csr.org.

1.3 Changes to GAP Approach Over Time

This GAP Manual is an update of the October, 2001 Manual. It is intended to provide sufficient clarification on how each type of municipality (small, medium or large municipalities, with simple, typical or complex waste management systems) can fill in the GAP Spreadsheet with their own data. The document summarizes decisions made during discussions at GAP Team meetings between December 1999 and June 2000, and subsequent feedback from municipalities in 2001 to 2003 across Canada whohave implemented GAP.

It is anticipated that minor modifications will be made to the Residential GAP reporting methodology and protocol as more municipalities work through the details and provide feedback. Updated versions of this document will be issued to address these modifications as required.

GAP is considered a “work in progress” and changes are made to the GAP Protocol on an on-going basis, based on feedback and suggestions from users, and also discussions of the GAP Team. Updated approaches are discussed with the GAP Team, which meets by teleconference 4 to 5 times per year, and changes in the GAP approach which have been agreed by the GAP Team are documented on the GAP website. The GAP Team includes representation from municipalities, NGOs, private sector industry provincial and federal government representatives from across Canada. It has been structured to provide input on issues faced in different parts of Canada, but recognizes that all issues have not been identified to date. Constant input from a diverse range of users assists significantly to the value of GAP.

We welcome feedback from all GAP users, as this helps to continuously refine and improve the GAP process and different GAP products.

1.4 How To Fill In A Residential GAP

A GAP Workbook has been developed in Excel format to assist municipalities in summary reporting of residential waste management system flow, municipal solid waste management system flow, and residential waste management system costs.

The GAP Residential Waste Flow Chart) is generated using data submitted in the first Spreadsheet of the GAP Workbook, or by filling in a GAP Short or Full Questionaire,

located on the GAP website. Contact gapinfo@csr.org, or phone 647-777-3356 to obtain the GAP Spreadsheet by e-mail.

Appendix C provides estimates to assist with tonnage calculations where weight data are not available.

2.0 GENERAL PRINCIPLES

General principles agreed by the GAP Team are:

- ***General Principle #1:*** *Tonnes will be used as the unit of measurement*
- ***General Principle #2:*** *kg/capita will be the common reporting unit*
- ***General Principle #3:*** *Local circumstances will be taken into account*
- ***General Principle #4:*** *Waste quantities from unusual events (e.g. storms, floods, etc) should not be used for comparison in the annual report*

The rationale for each of these principles is contained in this section.

2.1 Common Units of Measurement

General Principle #1:	**Tonnes are used as the unit of measurement in Residential GAP**

Tonnes are the unit of measure used in GAP. Where weigh scales are available, tonnage information is generally maintained at landfills, material recovery facilities (MRFs), composting facilities, etc. For municipalities who do not have weigh scales, Appendix C contains tables which show how to convert volume data (expressed as cubic metres or cubic yards) into tonnes.

2.2 Common Reporting Unit

General Principle #2:	**kg/capita is used as the common reporting unit**

Municipalities who take part in Residential GAP report the total tonnes of waste managed by different methods (described in Section 4). This information needs to be converted to a common base for comparison with other municipalities.

It is clear that reporting total tonnes of waste disposed or diverted by a municipality has limited value for comparison purposes, unless a common reporting unit to compare "apples to apples" is used.

Two measures are often used for this purpose:

- kg/capita/year, or
- kg/household/year.

The features and size of households in different communities in Canada vary considerably. Many multi-family units (e.g. in Vancouver) may have only one occupant, whereas single-family households in other parts of Canada may have three to five or more occupants. For this reason, the total population of a municipality is considered a more suitable measure than the total number of households for Residential GAP. Population is considered a reasonable denominator, therefore kg/capita/year will be used for comparative purposes.

The total population of a municipality can be found from a number of sources:

- Statistics Canada Census Data is collected every 5 years (when using this data verify that the boundaries used are the same as those used by the municipality);
- Many municipalities have developed population estimates for a number of different purposes. These are generally available through the Planning Department;
- Municipal directories often include population estimates by municipality. These generally differ from Statistics Canada information, and are updated every 2 years.

It may be necessary to estimate the population for a given year using a few sources, or by interpolating from population data from other years.

2.3 Comparing Different Municipalities

General Principle #3:	**Local circumstances will be taken into account**

The waste generation and disposal rates and diversion performance of different municipalities can be compared, as long as commonly agreed methodologies are used in both cases.

Local circumstances make some inter-municipal comparisons challenging for particular waste streams. The most obvious example of this situation is yard waste. Municipalities in warm, wet climates will generate considerably more yard waste per capita than municipalities with short growing seasons (e.g. Vancouver

vs Yellowknife). Also, older, mature municipalities with large trees will generate more leaf waste than younger municipalities.

2.4 Unique Events and Special Circumstances

General Principle #4:	**Waste quantities from unusual events (e.g. storms, floods, etc) should not be used for comparison in Residential GAP annual reporting.**

Special circumstances, which generate high quantities of waste in one year (e.g. demolition wastes that were generated as a result of events such as the Red River floods or the Quebec Ice Storm) should be identified separately as related to a unique event, but not be included in the year to year comparison with other communities.

3.0 DEFINITION OF WASTE TYPES

The use of common conventions and definitions among all parties is essential to the success of the Residential GAP protocol. This section describes the meaning of various definitions to be used in Residential GAP. Significant effort has been taken to ensure that the rationale behind the definitions is transparent.

As a general rule, the source of the material, i.e. residential, IC&I (industrial, commercial, institutional), etc. should be the primary determinant of waste flow categorization, not the service provider. For instance, residential apartment waste collected by a private contractor is considered residential waste.

3.1 Definition of Municipal Solid Waste

Waste is broadly defined as all discarded materials, regardless of how they are managed. The following definition of municipal solid waste (MSW) was developed by the GAP Team as part of the MSW GAP process in 2002:

MSW (municipal solid waste) is any material for which the generator has no further use, and which is managed at waste disposal, recycling or composting sites. This definition specifically excludes:

- *wastes that are associated with primary resource extraction or harvesting;*
- *agricultural wastes;*
- *mining wastes;*
- *conventional air pollutants;*
- *liquid effluents discharged from processing or manufacturing sites;*
- *nucleur wastes;*
  liquid and hazardous wastes (except for household hazardous waste);
- *auto hulks;*
- *pathological wastes;*
- *gaseous wastes, and*
- *gravel and rocks.*

The MSW definition includes waste from residential sources which is managed both on and off-site, and waste from IC&I (Industrial, Commercial and Institutional) sources which is managed off-site. This approach is consistent with approaches used by Statscan and provincial governments, where large amounts of waste managed on-site (where they are generated) are not of interest in waste flow and diversion reporting, whereas residential waste managed on-site by methods such as backyard composting count towards waste diversion. This approach acknowledges that on-site waste management efforts for residential waste reduce the requirement to collect and process this waste, and therefore result in reduced waste management costs.

Wastes from construction and demolition activities which are disposed at municipal waste landfills, construction and demolition waste reused on-site and biosolids from municipal waste treatment systems which are managed at landfills are addressed in MSW GAP.

Household special waste (HSW)[1] is included in the definition of municipal solid waste, as it is frequently contained in municipal solid waste streams, although significant efforts are now being made to recover and address HSW separately from the non-hazardous residential waste stream. The management of hazardous waste from IC&I generators is regulated at the provincial level, and is outside of the scope of the Residential GAP process described in this document.

3.2 Residential Waste

Residential waste refers to waste from primary and seasonal dwellings, including all single family, multi-family, high rise and low-rise residences in urban and sub-urban areas.

Residential waste includes:

- Waste managed on-site through activities such as backyard composting and grasscycling[2];
- Waste collected by the municipality (either using its own staff, or through contracted companies); and
- Waste from residential sources that is self-hauled to depots, transfer stations and landfills.

Particular situations involving residential waste are clarified below, to ensure that there is no confusion about special circumstances:

1. **Bulky and C&D Waste**: Bulky items include old furniture, old appliances, etc. generated by households. Renovation wastes generated by DIY (do it yourself) activities, etc., from residential dwellings. These wastes are often managed by self-hauling rather than by the municipal collection system. They are included in residential waste quantities in GAP. Renovation waste generated by contractors working in the residential sector is considered to be commercial waste and is not included in the residential waste stream in GAP.

2. **Multi-Unit Residences:** Waste generated by high-rise multi-family units, low-rise units and condominiums is included in Residential GAP. Some municipalities provide collection service for multi-unit dwellings, in others the building owners contract privately for collection, and in some municipalities there is a combination of the two types of service. All of this waste is included in the residential waste definition[3]. Renovation waste from apartments is considered commercial waste,

1 HSW (also known as Household Hazardous Waste – HHW) refers to waste materials generated by residential households (single and multi-family units) that cannot be collected in residential materials recycling programs. HSW consist of solid or liquid materials, or containers holding gasses, which have outlived their usefulness. This waste may be flammable, corrosive, explosive or toxic. Because of the possible danger posed by HSW, these materials should not be disposed of in landfills or sewage systems.

2 These activities are included, because they lower the residential waste management burden on municipalities.

3 Records can be obtained from contractors and building owners. Where only collection frequency and bin volumes are provided, tonnages can be estimated using conversion tables in Appendix F.

particularly if handled by a commercial contractor, and is not included in residential waste totals.

3. **Institutional Residents:** Waste generated by institutions where people are in full time residence for a period of time (e.g. senior citizens homes, prisons, university residences, etc.), which is picked up under private contract (i.e. not through the municipal waste collection system) is considered institutional waste[4]. If this waste is picked up with residential waste (only likely for situations such as a small seniors home in a residential area) it is considered residential waste.

4. **Large Student Populations:** Waste generated by students living off-campus is likely to be picked up with the residential waste stream. However, the waste generated in student residences will probably be picked up under contract as institutional waste, and will not be counted in the residential waste total, per item 3 above.

5. **Cottage Areas:** Where a municipality has a large seasonal population, the number of seasonal homes should be identified if possible. These should be multiplied by an occupancy factor of 17% to reflect occupancy 2 months per year, (depending on the location) to convert the seasonal population to an "equivalent permanent population". The reduction in permanent population in municipalities where seasonal home owners or renters spend the remainder of the year is ignored for this assessment, as the impacts are not considered significant.

6. **Residential waste disposed outside the home** (e.g., at gas stations, parks, etc) is not included in Residential GAP, as this information would be difficult to collect with any degree of accuracy. This is not expected to be a significant component of the residential waste stream, and it will be captured in the commercial waste stream addressed in MSW GAP.

7. **Residential do-it-yourself renovation waste** should be included in Residential GAP where data are available. In some locations, DIY waste is dropped off at the landfill at some or no charge, but tonnages are inconsistently tracked. The number of drops, if available, should be multiplied by the best estimate of average load weight (from scales data if available), and a best estimate of the proportion from DIY home renovators should be identified by the staff person that is completing the GAP Residential Waste Flow Form, to develop a best estimate total for this waste. This will be challenging in some locations where residential renovation waste is classified as commercial waste.

3.3 IC&I Waste

IC&I Waste (Industrial, Commercial, Institutional)[5] is waste generated by all non-residential sources in a municipality, and is excluded from Residential GAP[6]. This includes:

T[4] The GAP 1 Team considered developing separate estimates for institutional residential waste, which is residential in nature and composition. However, it was concluded that identifying the residential component of this waste stream, which is picked up with other commercial waste, is too problematic for the GAP Residential Waste Flow Chart. It is recognized that this approach may lead to small errors in the total residential waste flow, but a consistent approach will allow for relative comparisons.

5 Distinguishing between the separate components of IC&I waste is difficult and often inaccurate, even where this waste is managed at municipal landfills. FEL (front end loader) loads frequently contain waste from all three sectors, but the load has to be categorized as coming from one sector, therefore the available data is likely to include some inaccuracies.

6 Preliminary discussions are currently underway at an international level to possibly use the following categories for IC&I waste: Industrial, and Commercial, Institutional and Service waste for the current IC&I waste stream. Service waste is probably close to our definition of commercial waste, and is used by

- **Industrial waste** generated by manufacturing, and primary and secondary industries, and is managed off-site from the manufacturing operation. This waste is generally picked up under contract by the private sector. Readily accessible records are not generally available for the public or municipal staff on the amounts of industrial waste generated within municipal boundaries[7];
- **Commercial waste** generated by commercial operations such as shopping centres, restaurants, offices, etc. Some commercial waste (from small street-front stores, etc) may be picked up by the municipal collection system along with the residential waste[8]. The waste is dealt with separately as non-residential municipally managed waste (NRMMW) in MSW GAP, and should not be included in residential waste quantities reported in Residential GAP.
- **Institutional waste** is generated by institutional facilities such as schools, hospitals, government facilities, seniors homes, universities, etc. This waste is generally picked up under contract with the private sector.

3.4 Construction and Demolition (C&D) Waste

C&D waste, also referred to as DLC (demolition, landclearing and construction waste), refers to waste generated by construction and demolition activities. It generally includes materials such as concrete, brick, painted wood, rubble, drywall, metal, cardboard, doors, windows, wiring, etc. Large amounts of this waste are generated when the economy is prosperous, resulting in the increase of new construction and renovation activities.

The C&D waste stream is generally managed separately from other municipal solid waste (the residential and IC&I waste streams) because of the different waste composition and diversion opportunities involved. A number of landfills across Canada accept C&D materials exclusively, with various on-site diversion activities.

Residential GAP focuses on the C&D material **generated by do-it-yourself activities in residential dwellings**, that is collected through residential curbside pick-up or self-haul drop-off. Larger amounts of C&D material generated by builders contracted to carry out residential renovation or construction is considered part of the commercial waste stream, and is outside the scope of Residential GAP.

representatives in Mexico to describe waste from tourist operations, etc.

7 3Rs quantities for this waste stream are generally difficult to obtain, garbage quantities may be more readily available, particularly in municipalities where this waste is exclusively taken to the municipal landfill. Where such waste is exported, quantities will not be known, but may be estimated if the waste was previously managed by the municipality prior to export.

8 Availability of data on this sector will vary by location.

3.5 Household Special Waste

Household Special Waste (HSW)[9] consists of materials generated by residential households (single and multi-family units) that cannot be collected in standard residential recycling programs, and present a risk to municipal waste management systems because of their hazardous and toxic nature. HSW includes solid or liquid materials, or containers holding gases, which have outlived their usefulness. This waste may be flammable, corrosive, explosive or toxic and therefore HSW should not be disposed in landfills or sewage systems.

3.6 Waste Managed by Municipalities

Municipalities generally manage most residential waste generated within the municipality as well as some commercial waste from small businesses along the municipal collection routes, and in some cases, waste for which the municipality provides drop-off opportunities at depots, transfer stations or landfill sites. The rules on what amount of non-residential waste is picked up or permitted at drop-off sites varies by location.

Municipalities also generally manage the waste from their own operations (parks, maintenance yards, municipal buildings, road sweepings, etc.). This waste typically arrives at the disposal site in separate vehicles e.g. works department vehicles, and may be recorded under a separate category, allowing tonnages to be identified separately from curbside and front end loader (FEL) garbage.

The non-residential component of the municipal waste stream is excluded from Residential GAP, but is addressed in MSW GAP, where a non-residential municipally managed waste (NRMMW) waste category is identified.

9 The term HSW (household special waste) is recently replaced the term HHW (household hazardous waste).

4.0 DEFINITION OF WASTE MANAGEMENT ACTIVITIES

This section defines general terms used in the waste management business, and clarifies how these terms are interpreted in the Residential GAP. These general terms refer to a number of different cells in the GAP Spreadsheet described in Section 5.

4.1 Residential Waste Generation

Residential Waste Generation = Disposal + Diversion

Residential waste generation refers to all waste generated from dwellings (at the home or place of residence), where residential activities (food preparation, gardening, etc) are the source of the waste. It is calculated in Residential GAP as disposal plus diversion.

4.2 Residential Upstream Reduction

The Residential Property Boundary is the Boundary for Residential GAP Waste Estimates – "Upstream" Activities Are Not Included

Upstream reduction refers to actions taken prior to, or upstream of the household, that decrease the amount of residential waste generated within the residential property. It refers to activities that reduce the weight and/or volume of one or more types of waste generated by residences.

Examples of upstream reduction of residential waste include product design for durability and lightweighting of packaging. Upstream reduction activities are not included in Residential GAP, as the residential unit is the boundary for Residential GAP.

4.3 Residential On-Property Management

On-property management refers to actions taken to reduce the amount of waste produced by a household that would otherwise be managed off the property, either through curbside pick-up or drop-off to a waste management facility (depot, transfer station, landfill, etc.).

Residential GAP defines On-Property Management as:

- Backyard composting;
- Grasscycling;
- Evapotranspiration between the household and the curb. This is only applicable where municipalities use aerated carts for source separated organics collection, and it refers to the weight reduction which occurs between the house and the curb as a result of evaporation of some of the moisture from the organics. The weight of waste managed by the municipality is reduced as a result.
- Use of garburators; garburators are considered diversion if all biosolids treated at the pollution control centre are beneficially used (e.g. landspreading). If biosolids are landfilled the waste managed in garburators is counted as disposal, and if the biosolids are incinerated, the waste managed in garburators is considered recovery or disposal, depending on location.
- Open burning;
- Burning of waste within the home (e.g. papers in the fireplace).

For Residential GAP:

- Backyard composting, grasscycling and evapotranspiration are always considered **diversion**.
- Waste managed by garburators is considered diversion if the biosolids are beneficially used, recovery/disposal if the biosolids are incinerated, and disposal if the biosolids are landfilled.
- Open burning and burning of waste within the home are considered **disposal**.

4.4 Reuse

Reuse refers to situations where a used product or material that has been discarded by its owner (e.g. an old sofa or used clothing from a household) is reused for the same purpose, with minimal, if any processing. Reuse can occur through:

- The provision of municipal recycling depots and reuse or exchange centres;
- Existing private sector non-profit social service group networks (e.g., Salvation Army, Goodwill, etc);
- For-profit groups such as second hand stores that handle a variety of goods[10]; and

[10] It is expected that information on waste quantities may not be readily available in this category of reuse.

- Neighbourhood swap days and garage sales[11].

Residential GAP acknowledges reuse as an activity that reduces the amount of residential waste which requires management, but only includes municipally sponsored reuse activities (see section 5.7)

4.5 Refilling

Refilling is a form of reuse that is addressed separately in Residential GAP.

Refilling containers such as soft drink containers and beer bottles contributes to a reduction in waste requiring disposal. Through refilling, glass bottles are reused 15 to 20 times before being discarded and recycled.[12]

Refillable systems result in a reduction in the amount of waste entering the waste stream, and are acknowledged in Residential GAP through lower disposal values. Where refillable containers are used as part of a deposit-refund system, they are counted in the deposit-return and stewardship part of Residential GAP, described in Section 5.

4.6 Recycling

Recycling is defined as the process whereby a material (e.g., glass, metal, plastic, paper) is diverted from the waste stream and remanufactured into a new product, or used as a raw material substitute. Transparency is important when defining recycling. The following types of recycling are typically practiced by municipalities:

11 It is expected that information on waste quantities may not be readily available on this category of reuse.

12 Press Release: Beer Store Customers to Get Free Tips on How to Use It, Reuse It this Earth Day, Canada NewsWire, April 20, 1999 (www.newswire.ca/releases/April1999/20/c4171.html).

Closed loop recycling refers to the reincorporation of a material back into a product that has a similar use and composition to the product from which it was derived. Examples of closed loop recycling include:

- Recycled office paper being manufactured into a new paper product;
- Aluminum cans being manufactured into new aluminum cans;
- Glass bottles being manufactured into new glass bottles.

Open loop recycling refers to instances where a material (e.g. glass), is collected by a recycling program in a location where it is not viable to use traditional closed-loop markets that convert the recovered material back into new material of a similar nature. Instead, beneficial uses for the material that displace virgin resources and reduce the demand for extracting natural resources are found. Open loop recycling is also referred to as beneficial or local use recycling.

The GAP 2003 Team has spent considerable effort in developing a definition of beneficial use and evaluating how certain beneficial use practices should be counted in Residential GAP. The draft beneficial use paper can be obtained from gapinfo@csr.org

Recovered recyclables or other discarded materials are sometimes used in civil engineering projects. The use of a particular material is selected by a professional with appropriate experience for its engineering or agronomic qualities.

Examples of open loop recycling include:

- Use of crushed glass for road bed and other construction materials;
- Use of chipped wood waste as intermediate landfill cover;
- Use of residues from composting or other biological treatment systems as landfill cover;
- Use of shredded tires in place of aggregate.

Beneficial Use: The GAP Team has had a number of discussions about beneficial uses of recovered material, and identified cases where these uses should or should not be considered diversion. Appendix D contains the full text of the Draft Beneficial Use Paper (dated April, 2003). GAP Team discussions on various examples have agreed so far that:

- **Incinerator ash used as landfill cover** is not diversion, as the material has already been counted once as disposal when it went into the incinerator in the first place (we may need to discuss the concept of recovery within incineration);

- **Incinerator ash used as roadbed material or feedstock to new manufacturing** is not counted as diversion because it has already been counted as disposal when it entered the incinerator. This decision may need to be revisited in light of the definition "landfill capacity conservation" put forward by Ontario (discussed below).

- **Poor quality compost used as landfill cover** was discussed at the January 13th GAP meeting. The feeling was that this material has been processed already, and therefore was entitled to be considered as diversion, and is used at the landfill because paying markets can not be found;

- **Good quality compost used as landfill cover** is likely considered diversion given the definition put forward by Ontario that if it could be used at an alternative location, it is legitimate diversion.

- **Crushed glass used for road construction at landfills** is considered "reuse" by some GAP team members (counting towards diversion). It also meets the criterion of having been processed in some way (a requirement to be counted as diversion). It also meets the "landfill conservation" criterion.

- **Crushed glass used for cover at landfills** is not considered diversion by the Manitoba Product Stewardship Council when allocating diversion grants to municipalities (Dave Crawford to explain April 14th)

- **Crushed glass as aggregate substitute in construction projects outside landfill** is considered diversion by definitions used in Ontario and BC (confirm April 14th);

- **Shredded tires as road stabilization material within landfill**, discuss April 14th;

- **Ground wood or mulch as landscaping material within landfill** is likely diversion (Durham Ontario has used large amounts of this material at a rural landfill;

- **Ground wood or mulch to rehabilitate city properties outside the landfill** is considered diversion, even though if the City were to purchase material, it might purchase a smaller amount

- **Ground wood as final cover for landfill,** discuss April 14th;

- **Ground wood or mulch for maintenance of city properties outside of landfill**. Assume diversion but discuss situation where more is used than if the material had to be purchased (confirm this still viable diversion)

- **C&D material used for landfill roads or cover material**. Most or all C&D material is from commercial sources. GAP should have a rule that none of this material counted towards residential GAP diversion

Discussions are on-going and these decisions may be modified by the GAP Team over time.

4.7 Biological Treatment of Waste

Biological treatment refers to the processing of readily biodegradable waste to stabilize the organic material and produce an end product that can be used as a

soil conditioner. This approach has the benefit of reducing the amount of waste requiring landfilling, through a combination of moisture and other process losses (e.g. biomass reduction), with the added benefit of the creation of a useful end product.

Composting is an aerobic biological treatment process that is currently used across Canada to manage biodegradable residential waste, such as leaf and yard waste and/or food wastes and some paper products.

Anaerobic digestion is a process that is used to process municipal waste in a number of locations in Europe, and in three Ontario locations (Toronto, York and Guelph). In the anaerobic process, biogas (about 50% to 60% methane) is produced from biodegradation of the organic material in an anaerobic environment (with no oxygen). The biogas can be used as a fuel source, thereby offsetting the need to purchase fossil fuels or other sources of energy.

4.8 Energy Recovery and Incineration

Recovery[13] involves the destruction of waste and the capture of energy in a number of different processes. Through recovery, waste is effectively destroyed and no longer exists in its original form for handling within the waste stream. Examples of recovery include:

- Incineration or gasification of residual waste with recovery of energy[14];
- Burning used oils or solvents in boilers (displaces the need to buy additional fuel);
- Burning tires in industrial processes (e.g. cement kilns), which displaces the need to purchase additional fossil fuel.

Incineration achieves destruction of the material incinerated and precludes future use of this material. In general, energy recovery at incinerators is an added benefit/by-product. Most jurisdictions in Canada consider incineration to be disposal.

Very few Canadian municipalities dispose of municipal solid waste at incinerators, with residuals going to landfill. Those municipalities who do incinerate include: Burnaby, BC; Peel, On; Quebec City, Charlottetown, PEI and Wainwright, Alberta and some small units in other locations. All of the larger and newer incinerators

13 In British Columbia, the definition of recovery is the reclaiming of recyclable components and/or energy from the post-collection solid waste stream by various methods, including but not limited to manual or mechanical sorting, incineration, distillation, gasification or biological conversion other than composting.

14 In both Ontario and Nova Scotia, incineration with or without energy recovery is considered disposal. In BC, incineration with energy recovery is considered recovery, the 4th R, but is not counted toward achievement of the provincial reduction goal, and incineration without energy recovery is considered disposal.

include energy recovery. However there are a few remaining, smaller incinerators across Canada who do not recover energy from incineration.

4.9 Landfill Mining

Landfill mining has only been carried out at a few locations in Canada (e.g., Barrie, Ontario), and in the US (e.g., particularly communities in Florida, New York State and Pennsylvania). It is therefore not common practice at this time, but it may increase as landfill resources become more valuable in future.

Landfill mining recovers landfill capacity and can generate material for use as landfill cover; glass and metals are typically recovered from the mined material When a landfill mining project occurs, special mention noting this as an "exceptional" event should be made in Residential GAP. Where materials such as metals and glass are recycled as a result of the landfill mining project, these can be counted as recycled tonnes by the municipality in the year when they are recycled.

4.10 Landfill

Unprocessed garbage and residuals from processing operations (MRF residues, incinerator ash, compost residues, mixed waste processing and composting residuals, etc) are generally disposed at landfills in Canada. Landfill requires on-going monitoring and perpetual care, and the potential for landfill gas recovery or landfill mining now or in the future.

The amount of waste sent to landfill should be reported in Residential GAP, regardless of the location of the landfill used. In this way, municipalities account for residential waste generated within their boundaries which is exported outside of their boundaries for disposal.

4.11 Current Waste Diversion Definitions and Goals Across Canada

Diversion (sometimes referred to as reduction in waste disposed) refers to activities that handle a portion of generated waste in such a way that it is not disposed. Through diversion, waste disposal is avoided through a combination of processes and actions.

The Residential GAP Team has elected to use a "current year" diversion approach, where diversion is defined as follows:

Generation = Diversion + Disposal

Diversion = Recycling + Composting (or Digestion) + Reuse + On-Property Management

Diversion Rate = Diversion/Generation x 100 (%)

Information for the "current year" is used to carry out the Residential GAP diversion calculation.

Some provinces compare disposed waste per capita for different years to measure progress towards higher diversion. Table 4.1 summarizes how diversion and/or reduction in waste disposed is measured in different ways by different communities across Canada. Many provinces measure diversion progress as a reduction in disposed waste per capita, measured against a historical baseline. The Residential GAP Chart presents generated, diverted and disposed residential waste expressed in kg/capita units. This allows municipalities to compare their generation, diversion and disposal performance against whatever measure is used locally, and also to compare their residential systems with those of others across Canada using a common reporting unit.

Section 5 outlines the method agreed by the GAP Team for filling in each cell of the Residential GAP Spreadsheet, including how to calculate diversion on a current year basis.

TABLE 4.1

Current Waste Diversion Definitions And Reduction Goals In Some Canadian Jurisdictions

JURISDICTION	METHOD OF MEASURING DIVERSION OR REDUCTION IN WASTE DISPOSED
Canadian Council of Ministers of the Environment (CCME)	50% reduction in per capita waste disposed and 50% reduction of disposal of waste packaging, compared to 1988 base year level.
Federation of Canadian Municipalities (FCM)	
British Columbia	In 1989, British Columbia adopted the goal of reducing the per capita amount of municipal solid waste (MSW) requiring disposal by 50% by the year 2000, compared to 1990 disposal rate of 0.944 tonnes/capita. The reduction goal was to be achieved through the first 3 Rs of the reduce, reuse, recycle, recover and residual management hierarchy. A 32% value was reached by the end of the year 2000. The province does not have an official target at this time. A number of BC municipalities have adopted zero waste strategies.
Yukon	
Northwest Territories	
Nunavut	
Alberta	Interpreted CCME goal as 50% reduction in waste going to landfill (i.e. disposal) by 2000. Set goal of 50% reduction in MSW landfilled on a per capita basis by 2000, using 1988 as base year. Modified this in 1998 to "continuous reduction in MSW to landfill on per capita basis". Draft Waste Action Plan 2002-2005 has a target to reduce the amount of waste going for disposal in municipal landfills to 500kg/capita per year by 2010.
Saskatchewan	No specific diversion goal at this time
Manitoba	Manitoba was committed to achieving a 50% reduction in the per capita generation of waste by the year 2000. The Waste Reduction and Prevention Act enables a variety of regulatory responses to assist in achieving this goal. The Final Report of the Regional waste Management Task Force: Regional Integrated Waste Management Plan and Recommendation, December, 1999 recommended that the province continue to work towards achievement of the waste reduction target of 500 kg/cap of solid waste going to landfill
Ontario	Ontario's waste reduction goal is to reduce the quantity of waste disposed of per person by 50% relative to the 1987 quantity which was 1.015 kgs per capita. The " waste reduction rate" calculation is: (kgs disposed of per capita in 1987 minus kgs disposed of per capita in the current year) divided by (kgs disposed of per capita in 1987). It is expressed as a percent.
Quebec	Quebec Residual Materials Management Policy 1998-2008 sets a goal of recovering 65% of the 7.1 million tonnes of residual materials that can be reclaimed each year.
New Brunswick	"Waste Reduction and Diversion: An Action Plan for New Brunswick", Fall 2001 focusses on organic waste diversion. No specific goal is identified.
PEI	Island Waste Management Corporation is aiming for 65% diversion.
Nova Scotia	When the Nova Scotia Environment Act became law in January, 1995, the province formally adopted the Canadian target of 50% diversion of solid waste from disposal by the year 2000. The Act also committed the Department of the Environment to develop a comprehensive strategy for the management of solid waste resources in Nova Scotia. That commitment resulted in the November, 1995 release of the document, "Solid Waste Resource Management: A Strategy for Nova Scotians". [15] Nova Scotia reached its goal of 50% waste diversion in

15 'Nova Scotia The North American Leader in Recycling and Composting, Nova Scotia Resource Recovery Fund Board, (www.gov.ns.ca/envi/wasteman/50by2000/50by2000.htm)

	2000. The Province states that it plans to continue its success by focusing its attention on ensuring all Nova Scotians have access to recycling and composting.
Newfoundland and Labrador	Newfoundland and Labrador Waste Management Strategy, Department of Environment, 2002 sets a goal of diverting 50% of what currently goes to landfill by 2010

5.0 FILLING THE GAP QUESTIONNAIRE AND SPREADSHEET

This section of the Residential GAP Manual provides direction on how to collect and summarize information on the flow of residential waste in various parts of the residential waste management system, and how to report these estimates in the Short or Full Residential GAP Questionnaire (available on the GAP website) , or in the GAP Residential Spreadsheet section of the GAP Workbook (available in electronic format from gapinfo@csr.org).

The GAP Workbook is designed to generate as many calculations as possible automatically, to minimize the amount of effort required by the municipality.

When the Residential GAP Questionnaire or Spreadsheet is completed, a Residential GAP Waste Flow Chart is created and is sent to the municipality for verification and approval. It can then be added to the GAP web page. This allows municipalities across Canada to compare their residential waste management system and statistics to other municipalities on an “apples to apples” basis.

It should be noted that the residential waste stream composition and quantities will change over time, as technology and packaging changes are implemented. However, the method proposed should remain valid for 3-5 years, as changes are expected to occur slowly and incrementally over time.

The issue of materiality (i.e. how significant is the amount involved) governs much of what is in this section, i.e. if the quantities of waste involved are small, significant effort should not be expended to increase the accuracy by 1%. However, if the amount involved is more significant, more effort should be made to estimate the quantity, and the basis of the estimate documented. The discussion of materiality may be limited by the amount of information that can be collected and monitored.

5.1 A Cells – Residential On-Property and Summary Cells

Cells with the prefix “A” are found at the left-hand side of the GAP Residential Waste Flow Chart and Spreadsheet. These cells generally contain summarized information generated by later cells in the spreadsheet. Cell A1 is the only cell where data from the waste management system needs to be identified. Information in the other cells is automatically estimated by the spreadsheet when cells in the B column (and in a few cases, cells in the C column) of the Residential GAP spreadsheet are completed.

5.1.1 Cell A1 – Residential On-Property Management

Source reduction and on-property management refers to all activities which occur after waste is generated at the household, and which reduce the amount of waste managed by others (picked up at the curb or dropped off at public sites). Activities that occur upstream of the house, such as lightweighting of packaging, are not specifically identified in Residential GAP, as the impacts of these activities are seen in a lower overall waste generation rate. For Residential GAP, source reduction and on-property management cover the following activities:

- Activities that occur on the property, or in the house and that divert waste from disposal; and
- Activities that occur on the property, but are considered waste disposal.

All residential waste generated in the household and managed on the property should be identified and included in Residential GAP.

Activities Upstream of the Home are Excluded: The GAP 2000 Team agreed that actions occurring upstream of the house (e.g. lightweighting of packaging or purchasing decisions that reduce the amount of waste generated, etc) are hard to measure or assign. Activities upstream of the house are outside of municipal jurisdiction, and some are also outside of the homeowners control, therefore the agreed convention is that the waste reduction impact of "upstream" activities (i.e. activities which occur before waste is generated in on the residential property) is not identified in Residential GAP.

Actions that Reduce the Quantity of Waste to be Managed are Counted: It was agreed by the GAP 2000 Team that if the waste is a material that was originally managed by the waste management system but is now managed on-property, it should be identified in Residential GAP. An example of this principle is waste that would previously have gone to the curb or be dropped off for disposal or management by the municipality that is now managed in a backyard composter.

Six different on-property management activities are addressed in Residential GAP:

- Backyard composting;
- Grasscycling;
- Use of garburators (considered disposal unless recovery for beneficial use can be identified);
- Evapotranspiration between the household and the curb (counted as diversion if source separated organics);
- In-home burning - e.g. newspapers in fire (considered disposal), and
- On-site burning - e.g. burning barrel and fire pits (considered disposal).

Where municipalities have developed their own estimates of the impacts of these various measures, these should be used in Residential GAP. The source of information used should be documented as a note in the GAP Questionaire or as a comment in the GAP Spreadsheet. Where no municipality-specific estimates have been developed, the default estimates presented in the following sections should be used.

Backyard composting: Table 5.1 summarizes information collected on the values used by different municipalities to estimate the annual residential waste diversion through backyard composters. To estimate the amount of waste diverted through backyard composters, the following steps should be taken:

- Identify the number of backyard composters sold through municipal programs;
- If the municipality has carried out studies to measure the impacts of backyard composting in their own locations within the last 3 to 6 years, then the locally measured value should be used, along with a description of how the value was measured;
- If recent, locally measured data is not available, the number of composters distributed is automatically multiplied by the GAP default value of 100kg/composter/year[16]. This approach takes into account the fact that usage of BYC is less that 100% and that some BYC which were not part of the municipal distribution program are used.

[16] This default is derived from City Of Ottawa research, 1999.

TABLE 5.1: Diversion Rates For Backyard Composters Used By Different Municipalities Across Canada

Municipality	Diversion	Source or Measurement Methodology
Barrie, ON	200 kg/hh/yr	Surveyed participation rates of 470-500 households in 1994. In 1997 gave scales to 20 households – this was a very small sample size and participants were largely Master Composters and their friends.
Bedford, NS	120kg/hh/yr	80 households selected from 330 BYC households (total 2,500 hh) to weigh kitchen waste to BYC for one year (Oct 1994-Sept 1995).
CRD, BC	278kg/ unit /yr[17]	Capital Regional District of BC includes 14 municipalities. Blended average of weight studies done in Hamilton-Wentworth and Durham from the early 1990's.
Central & South Hastings, ON	230kg/hh/yr[18]	Conducted a door-to-door survey: 28,707 households were approached and 17,286 surveyed. The total population estimated to be composting was 22,817 (70%)[19]. However, with a random check of BYC this estimate was reduced to 52%[20].
Cornwall, ON	144-240 kg/hh/yr[21]	
Durham Region, ON	253kg/ unit /yr	Reduction in weight of packer trucks (early 1990's).
GVRD, BC	250 kg/ unit /yr	Greater Vancouver Regional District: CH2M Hill/RIS study 1993 used data from Seattle, Peel, Durham, Waterloo, Pickering, Hamilton Wentworth to come up with value of 250 (lower than Seattle)[22].
Halifax, NS		BioLogic did a study in 1996. Clean Nova Scotia conducted a door-to-door survey in Summer 2000, to evaluate usage rates and numbers of households with BYCs.
Kingston, ON	144-240 kg/ unit /yr [23]	Recycling Council of Ontario Report (1994)
Lanark County, ON	150kg/ unit /yr	Door-to-door survey in 1996.
Markham, ON	250kg/ unit /yr	40 households selected through ad in the local paper. Staff weighed BYC contents once per week for one year. People were likely more diligent because they were being closely studied.
Orillia, ON		Door-to-door survey of 203 households to assess usage in 1994 and in May 2000.
Ottawa-Carleton, ON	100+/-20 kg/ unit /yr	Proctor and Redfern study conducted brief inspections and ranked BYC recentness of use, correct use, etc in 1998
Peel Region, ON	121 kg/ unit /yr	Exhaustive study carried out by Proctor and Redfern in 1993: surveyed 516 homes and found 44% had at least 1 BYC, 74% of these were in use. Thus it was estimated that 33% of eligible Peel residents were actively composting. Each unit is estimated to divert 121 kg/unit/year, resulting in an average of 159 kg per composting household per year. 20% of home composting is carried out in open piles or home made units.
Perth County, ON	120 kg/unit/yr	Surveyed 230 households to estimate number with BYC. 153 had composters
Peterborough, ON	150kg/unit/ yr[24]	City website

17 Telephone conversation with Tom Watkins, CRD Compost Education Centre, 250-360-3197.

18 Based on comparison with other municipalities. In 1994 used 132-215 kg/hh/yr.

19 *Yes In My Backyard Report*, 1994.

20 Telephone conversation with Marvin Tucker, Quinte Waste Solutions, May 10, 2000.

21 Ibid

22 Telephone conversation with Pamela Nel, Greater Vancouver Regional District.

23 *Backyard Composting Summary of Results of the Model Community Projects*, Recycling Council of Ontario, 1994.

24 City of Peterborough website: http://www.citypeterborough.on.ca/was/recycle.htm#TWO.

Municipality	Diversion	Source or Measurement Methodology
Pickering, ON	300 kg/unit/yr	Study in 1990 to evaluate BYC diversion rates – found 300kg/composter/yr . (later studies found it to be lower). Proctor and Redfern study found that participation dropped to 78% after 1 year.[25]
Toronto, ON	Used to use 200kg/unit/yr; now use 100kg/unit/year GAP default value	Conducted research in the early 1990's: residents were given scales to weigh materials being put in the BYC. The number was revised to 200kg/hh/y in 1997 based on results from other municipalities. The number was subsequently revised to 100kg/hh/yr in 2000 based on adoption of GAP methodology
Waterloo Region, ON	Use 150kg/unit/yr	Early studies based on packer truck weights (352kg/hh/y). These numbers changed over time as surveys were repeated. Most recent research year 2000 showing rates of 80-160kg/composter/year (not complete).

Grasscycling: Table 5.2 shows the diversion values **(as a % of the leaf and yard waste stream**) which should be used, depending on the grasscycling policies in place in the municipality[26]:

TABLE 5.2: Grasscycling Diversion Rates To Be Used in GAP

Grasscycling Program Elements	Diversion
▪ Promotion and education only	2% of leaf and yard waste stream
▪ Promotion and education ▪ Ban on grass clippings in leaf and yard waste pick-up	10% of leaf and yard waste
▪ Promotion and education ▪ Ban on grass clippings in leaf and yard waste pick-up ▪ Ban on grass clippings in garbage	15% of leaf and yard waste stream
▪ Promotion and education ▪ Ban on grass clippings in leaf and yard waste pick-up ▪ Ban on grass clippings in garbage ▪ Three-bag limit or lower for garbage, plus user pay	20% of leaf and yard waste stream

[25] *GTA 3Rs Analysis*, 1994, pg. C5.
[26] These default values have been agreed upon by the GAP Team in a full team meeting in February 2000.

Evapotranspiration Prior to Curb: Evapotranspiration is only considered relevant where aerated carts are used for management of source separated organics, and evaporated moisture can reduce the mass of waste to be managed.

A value of 10%[27] of the residential organic waste source separated by the household should be used by communities who use aerated carts for organic waste collection. If a different value is identified through field testing, and can be documented, it should be used

Those municipalities who do not use aerated carts should use a value of zero for evapotranspiration.

Garburators: The use of garburators varies by municipality across Canada**.** The GAP 2000 Team agreed that garburator waste which is digested and land applied could be counted as diversion, whereas other uses are counted as disposal. The diversion decision may be changed at a future time.

Waste disposed in garburators should be identified and counted as **disposed waste** unless it can be proven that the waste is recovered or diverted through some treatment or beneficial use process (landspreading, etc.).

If data are not available on the number of garburators in use, a value of zero should be used. Where garburator waste is included in Residential GAP, the following approach should be used:

- Identify the number of garburators in the municipality;
- Identify the final destination of the material processed by the municipal wastewater treatment plant (land applied, incinerated or landfilled);
- Multiply the number of garburators by 72 kg/hh/year[28] (assume 36 kg/capita/year and a household of 2 people).

Burning In Households and On-Site Burning and Disposal: Small communities represented on the GAP 2000 Team requested that burning in households be included in Residential GAP. It was also felt that on-site burning and disposal was a common practice in smaller and rural communities across the country. The Canadian Council of Ministers of the Environment (CCME) has carried out some initial research to identify the amount of waste burned in households, but the results are not public at this time. It is acknowledged that numbers may be impossible to estimate, for most municipalities, and in this case a zero value should be entered into Residential GAP.

27 Evapotranspiration prior to the curb in aerated organic collection carts has been measured in three studies of aerated carts: A study in Halifax, Nova Scotia in Summer, 1997 measured evapotranspiration at 47%, 21% and 33% from three different types of organic collection carts over a 2-week period; a study carried out by 2cg (a consulting company) in summer and fall, 1997 and winter 1998 measured evapotranspiration at 24% and 17% in summer and fall. Winter values were not reported; and a study in East Hants, Nova Scotia in summer, 1998 measured evapotranspiration at 13.5%, 18.5% and 23% for three different types of aerated organic collection *carts.*

28 Based on information from Halifax, 1996 Biologic study.

If estimates of these activitities are available, they are included in the waste stream going to Other Disposal (Cell D11).

5.1.2 Cell A2 Population and Household Data

Population and household data should be obtained from the municipality's Planning Department, or other sources noted in Section 2.2.

Ideally, the number of single family and multi-family households should be identified if available, but total households is sufficient if the breakdown is not available.

Total population is required to calculate all Residential GAP values as kg/capita/year. The GAP Spreadsheet automatically completes the calculations when the population data are entered.

5.1.3 Cell A3 Summary

All information in Cell A3 is calculated automatically from information entered elsewhere in the GAP Spreadsheet or provided in the GAP Questionnaire.

Residential waste generation is calculated as the sum of the waste disposed (either collected by municipalities, contractors or self-hauled to disposal sites and transfer stations) plus the waste diverted (i.e. through recycling, composting, reuse, etc).

Residential Waste Diversion includes most of the summary values presented in Cells D1 to D6 in the right hand column of the GAP Residential Waste Flow Chart. These include material diverted through deposit-return and stewardship systems, reuse, backyard composting, evapotranspiration, grasscycling, recyclables and organics diverted, and HSW material sent to reuse or recycling.

5.2 B Cells – Collection Cells

Cells with the prefix B are found in the column to the right of the A cells in the GAP Spreadsheet. The B cells focus on all **collection** activities for residential waste.

5.2.1 Cell B1 Residential Component of Stewardship and Deposit-Return Programs

Stewardship and deposit return programs refer to activities where certain components of the residential waste stream are managed through programs that are independent or parallel to the municipal waste management system. Stewardship programs exist in a number of provinces across Canada. Examples of stewardship and deposit return programs include programs to recover materials such as used oil, HSW, old telephone directories and deposit-return programs for soft drink and other containers in provinces such as Alberta, Saskatchewan, Nova Scotia, BC.

Various stewardship programs monitor returns differently, some by local area, some by larger region. This is complicated by the fact that a return depot in some regions may receive materials generated in several different municipalities.

Comprehensive information on stewardship programs across Canada is available on the website www.ec.gc.ca/epr.

In GAP, the allocation of material collected through stewardship programs is:

- 50% of beverage containers are assumed to be from residential sources;
- 5% of oil and tires are assumed to be from residential sources.

Table 5.3 summarizes the values used for different provinces and territories. If you are completing a Residential GAP and a specific value is not included for your area, contact gapinfo@csr.org.

Table 5.3

Default Values For Some Deposit-Return And Stewardship Programs

Province or Territory	Residential GAP Stewardship and Deposit Return Value
British Columbia	n/a
Yukon	n/a
Northwest Territories	n/a
Nunavut	n/a
Alberta	11.77 kg/cap
Saskatchewan	11.77 kg/cap[29]
Manitoba	11.77 kg/cap[30]
Ontario (Brewers Retail Refillable System)	2.61 kg/cap
Quebec	4.74 kg/cap
New Brunswick	n/a
Prince Edward Island	n/a
Nova Scotia	10.81 kg/cap
Newfoundland and Labrador	n/a

5.2.2 Cell B2 Residential Reuse

Residential reuse in Residential GAP refers to tonnages collected through **municipally sponsored or supported activities** such as bins in drop off areas or during special collection days to allow people to drop off used items, reuse centers such as the Halton Reuse Centre, etc. Records of tonnage from these activities are generally maintained and should be included in the Residential GAP.

If no **municipally sponsored** reuse activities take place, a zero value should be entered in this cell. The GAP 2000 Team felt that this approach was the most reasonable way to develop an “apples to apples” comparison between municipalities.

5.2.3 Cell B3 Curbside Residential Recyclables Collection

Information in this cell may be derived from actual data measured at the MRF (Cell C2) where recyclables are processed.

[29] Alberta value being used until Saskatchewan estimate finalized
[30] Alberta value being used until Manitoba estimate finalized

Records of recyclable materials delivered to the MRF should be obtained, and efforts should be made to allocate these between curbside and drop-off, if possible. This distinction is not essential, as Cell C2 (Recyclables Processed) identifies the important quantity for the Residential GAP Residential estimates. The quantity of recyclables collected at curbside from both single family and multi family households may or may not be measured separately from drop-off quantities, as both sets of materials may be delivered to the MRF or processor separately. Information on private recyclable collection systems which serve residences should be requested and added where available.

5.2.4 Cell B4 Curbside Residential Source Separated Organics Collection

The quantities of organic material (leaf and yard waste and household food waste) collected curbside will likely be available through transfer station or composting site records. These records should be examined to identify the correct value to enter into this cell.

5.2.5 Cell B5 Residential Bulky and Special Waste Collection

Some municipalities collect bulky goods curbside; some provide pick-up on a call-in basis; some provide pick-up on a fee for service basis, and some do not provide any direct collection service. Where a bulky and special waste service is provided, records of the amount of bulky and special waste collected are probably maintained by municipal staff. The information may be maintained as the number of units collected, or number of truckloads, and may not be reported by weight. Appendix C contains conversion charts that can be used for white goods, to convert the number of units collected to tonnes.

Any HSW collected by bulky and special waste collection systems should be recorded separately in Cell B5 because of special handling needs. Again, conversion tables are presented in Appendix C to convert the available information to weight information. The exact weight of lab packs may not be provided by HSW contractors, therefore in this case assume that lab pack contained 25% actual product (50% containers, 50% packaging; containers 50% full) and apply density measurements found in Appendix C.

It is acknowledged that many HSW containers received at HSW sites will be only partially full, or in fact may only contain some residue at the bottom of the container. This affects the overall weight of the container. In most cases paint is bulked up to larger units (drums) where volume can be converted to weight using the density factors shown in Appendix C.

5.2.6 Cell B6 Residential Drop off at Depots, Transfer Stations and Disposal Sites

Where residential recyclables dropped off at depots[31] (drop-off depot or transfer site), some of the dropped-off material will likely be from commercial sources. A "best guess" should be used to estimate what proportion of the total is residential. In the absence of more accurate estimates, an assumption that 50% of the total dropped off material should be used. This default was agreed upon by the GAP 2000 Team as the most reasonable value in the absence of other information.

Where records are maintained of the number of vehicles which dropped off garbage, assume that each vehicle dropped off 50% of the allowable limit.

Any HSW collected by these systems should be recorded separately in Cell B6 because of special handling needs.

5.2.7 Cell B7 Curbside Residential Garbage Collection

Curbside garbage collection records will be available for landfill sites and incinerators that have scales. These records will typically note the tonnages of residential garbage delivered to the disposal site each year. This value should be entered into Cell B7, indicating whether to landfill (the most common), energy from waste or mixed waste processing.

For larger sites, records should also be available on the amount of front-end loader (FEL) garbage collected from multi-family units, although this may be recorded as the number of pick-ups. The size of bins used, and conversion tables in Appendix F can be used to convert this information to tonnes. It may be challenging to collect this information from private haulers, depending on the nature of the contract.

Where no scales data are available, the number of truckloads can be used along with conversion tables in Appendix C to estimate the tonnage collected.

In most jurisdictions, larger, regional landfills have scales, and serve many communities and rural populations. Larger municipalities will keep records such as scale tickets in a format that can be used directly to fill in Residential GAP.

Privately collected residential waste is included in the residential waste total if records are available (see Section 3.2 for discussion). Records of waste picked up from apartments

[31] Where municipalities have curbside programs, depots may only account for 5% to 10% of the total residential recyclables.

and condominium developments can be obtained from contractors and building owners. Where only collection frequency and bin volumes are provided, tonnages can be estimated using conversion tables presented in Appendix F of this document.

If records are not available, but the number of single family, multi-family or condo units that are collected privately is known, then available information from similar units in the municipality should be used to develop an estimate per unit. This average value should be applied to all units for which information cannot be obtained. The calculation should take the presence/absence of recycling options into account, where known.

5.2.8 Cells B.8 & B.9

Cells B.8 & B.9 address the few communities who have wet and dry 2-stream collection systems. Sources of data are similar to those discussed above.

The dry material all goes to a MRF for processing and the wet material is directed to composting for processing. Both the wet and dry processing have elements of mixed waste processing technology.

5.3 C Cells – Processing Cells

Cells with the prefix C are found in the column to the right of the B cells in the GAP Residential Waste Flow Chart. The C cells describe all **processing** activities for residential waste. Sections 5.14 to 5.20 describe how to identify the information required to fill in the Cells C1 to C7.

5.3.1 Cell C1 Residential Component of Deposit, Return and Stewardship System Processing

The value inserted in Cell B1 is automatically copied to Cell C1. The GAP Spreadsheet assumes a 5% residue rate to calculate the net amount of material diverted.

5.3.2 Cell C2 Residential Recyclables Processing

Recyclables processing includes all materials collected from curbside (B4), bulky collections (B5), and drop-off sites (B6). It also includes material collected in the dry part of a wet dry system (cell B8). The GAP Spreadsheet automatically copies the amount collected into the amount processed cell.

Sufficient records are generally available to estimate the amount of material recycled. For municipalities with curbside programs, recyclables are generally sent to a MRF[32] for some level of processing prior to sale to markets.

The GAP Team agreed that measuring the tonnes collected does not provide an accurate estimate of the tonnes recycled. Residue is the 'great equalizer', which identifies the net amount of material recycled and allows comparison of the performance of different recycling processing systems. Therefore, residues are accounted for in Residential GAP reporting[33].

Cell C2 is set up so that the total tonnes of recycled materials received at the processing facility/MRF can be recorded, as well as the tonnes of residue produced (residue goes to disposal, and is automatically added to Cell D9 in the GAP Spreadsheet). The difference between these two figures is the amount recycled[34]

Records of tonnes marketed will typically be maintained at the MRF, through waybills, purchase orders, etc. In the case of a city such as Calgary, where recyclables are taken directly to the market without interim processing, or for white goods (most of which go directly to market), quantities recycled can be obtained from the contractor.

In some depot systems, the collected material is sold directly to end markets with no intermediate processing. In this case, record tonnages sent to markets, collected and processed and assume a 5% residue rate, unless the real residue rate was measured.

5.3.3 Cell C3 Residential Organics Processing

Where biodegradable organics (either leaf and yard waste, or combined with food waste) are picked up at the curb or are collected through drop-off depots, they will be taken to a processing plant (generally open windrow or enclosed aerobic composting, although anaerobic digesters are increasing in number).

Typically, for each 100 tonnes of material composted, about 40 tonnes of compost are produced, 20 tonnes (or less) of residue goes to disposal and 40 tonnes of mass reduction is achieved through moisture loss.

[32] The focus of the measurement effort is recycling at the MRF, rather than at later processing facilities (glass plants, mills, etc).

[33] The GAP Team agreed that the MRF was the easiest location to measure recycling tonnages. The measurement can be carried out at either the inlet or outlet of the MRF. Issues such as the build-up of inventory in the MRF need to be considered in the calculation.

[34] The GAP Team agreed that the MRF was the easiest location to measure recycling tonnages. The measurement can be carried out at either the inlet or outlet of the MRF. Issues such as the build-up of inventory in the MRF need to be considered in the calculation.

There are two major classifications of compost in Canada, which have been developed by the Canadian Council of Ministers of the Environment (CCME) and are being adopted by most or all of the provinces:

Class A – unrestricted, and

Class B – restricted.

The classes generally refer to high value horticultural or lower grade land reclamation uses, respectively. Both of these uses are considered diversion, and should be shown as Compost Produced in Cell C.3. The GAP 2003 team continues to debate how beneficial use, particularly within the boundaries of the landfill, counts towards diversion.

This cell should record the amount of organic waste delivered to the composting site, the amount of compost product produced, and the residue that required disposal from processing and screening. Tonnages of amendments should be excluded from the estimates in Cell C3, as they are continually reused/absorbed in the process. The moisture loss line item can be calculated from these values as follows:

Moisture Loss = Organics Delivered to Site – Compost Marketed – Residue Disposed.

Where residue values are not available, a 20% residue rate should be assumed as a default. This default value is set at a high rate to provide an incentive to municipalities to establish systems to measure the actual residue rate accurately in the future.

5.3.4 Cell C4 Additional Processing To Increase Residential Waste Diversion at Landfill or Transfer Station

This cell was added at the request of Alberta municipalities, as considerable activity occurs at landfill sites to reduce the amount of waste actually landfilled. The cell should be used to identify on-site diversion activities at landfills, drop-off sites or transfer stations, which require additional effort after material is dropped off to ensure that the material is put to productive use rather than disposed. This could include actions such as identifying loads with large quantities of wood or other reusable materials, which are diverted to useful purposes, including recycling or on-site operational uses.

It is likely that the amount of material that goes to this use from residential sources will be fairly low, and for most municipalities, the value may be zero.

5.3.5 Cell C5 HSW Treatment, Reuse and Recycling

HSW includes materials such as paint, pesticides, used oil, etc. Good records are usually maintained on the quantities of HSW collected.

If records are maintained of the HSW that is reused and recycled, rather than being disposed, this should be documented in this cell. A good approximate estimate can also be developed and used, as long as documentation of the assumptions is supplied.

Otherwise, all HSW should be considered disposed.

5.3.6 Cell C6 Residential Waste Incineration and EFW

There are relatively few municipalities in Canada to which this category will apply (Peel, Quebec City, Charlottetown, Burnaby, Wainwright, and a few small units in Nova Scotia).

The amount of waste from residential sources that is received at an incinerator is generally weighed at the scales; therefore records should be readily available.

Records are maintained for fly ash, bottom ash, recyclables recovered and any other process residue quantities generated. Moisture loss is calculated as the difference between the

tonnage of solid material into and out of the incinerator

Moisture Loss = Tonnage in – Fly Ash – Bottom Ash – Recyclables Recovered – Other Front End Processing Residues

Any recyclables recovered at the incineration plant are automatically added to the totals in Cell D4.

5.3.7 Cell C7 Residential Mixed Waste Processing

Relatively few municipalities in Canada have mixed waste processing systems. There are a few plants in Nova Scotia, one in Tracy, Quebec, two in Ontario (Toronto, Guelph), and a large plant in Edmonton, Alberta.

Where residential waste is directed to a mixed waste plant, the tonnage received should be split into the following tonnage categories:

- Deposit containers recovered;
- Recycled;
- Moisture/Gas By-product;
- Composed or digested, and
- Disposed as residue.

A mass balance will be required to identify moisture and process losses through the biological system. These should be identified in Cell C7 where noted. The recycled tonnes recorded are those materials which were marketed or used net of process residues.

5.4 D Cells – Summary

Cells with the D prefix can be found on the right hand side of the GAP Residential Waste Flow Chart. Values in D cells are automatically calculated by the GAP Spreadsheet, after data are entered into the B cells.

The D cells contain **summarized information** generated from other cells. This information is converted to a kg/capita value using the population data from Cell A2

APPENDICES

APPENDIX A.1
The GAP 2000 Team

GAP TEAM MEMBERS - APPENDIX A

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APPENDIX A.1
The GAP 2003 Team

GAP 2003 TEAM MEMBERS - APPENDIX A.1

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APPENDIX B

The Original GAP Team (2000) Terms Of Reference

APPENDIX B
THE GAP 1 TEAM TERMS OF REFERENCE

OBJECTIVES

◊ Develop a methodology for the measurement and reporting of waste system flow and diversion performance that will be accepted by practitioners and government agencies throughout Canada as an acceptable standard.

◊ Develop and achieve consensus on the diversion measurement methodology by Spring, 2000

COMMITTEE STRUCTURE

Chairperson

Geoff Rathbone, CSR

Co-Chair from Committee Membership

Members

Waste system practitioners (municipal, waste management industry) regulatory staff (provincial, federal) and NGOs (RCO, RCBC, etc) from across Canada.

CSR senior staff and technical support

Task Groups -Options

◊ Four or five separate Task Groups likely to address specific issues (incineration, composting, recycling, reduction, data management and reporting).
◊ Each task group addresses issue for finite period of time (three months)
◊ Integration Group pulls separate elements together into a cohesive methodology

◊ Alternatively, prepare 10 separate, short papers on different issues (two to three members tackle one subject together. Examples of topics include for example how poor quality compost used for landfill cover is counted, etc.).

MEETINGS

Main Group has three meetings (plus introductory) in period December 1999 to April 2000. Due to the cross-Canada nature of group, assume meetings will be by teleconference, and can be more frequent if required.

Assume three to four task groups will be formed. Again, these will likely comprise members from across Canada, so task group meetings would be by teleconference, unless budget set aside for travel. Task group meetings would be once per month.

PRODUCT

With the assistance of Maria Kelleher of Enviros RIS, the Team will produce a manual of generally accepted principles, definitions and formulas for calculating municipal waste flow and diversion.

Consideration will also be given to hosting a one day National Workshop to present the major findings and recommendations of the GAAP Team.

APPENDIX C
DENSITY CONVERSION INFORMATION

APPENDIX C
DENSITY CONVERSION INFORMATION

TABLE C.1 – Uncompacted and Compacted Densities of Different Materials

MATERIAL	UNCOMPACTED		COMPACTED	
	lbs/cubic yard	kg/cubic metre	lbs/cubic yard	kg/cubic metre
Paper				
Newsprint	360-505	214-300	720-1010	428-600
Ledger paper: flat	375-465	223-277	755-925	450-550
Ledger paper: crumpled	110-205	65-122	325	193
Computer printout	655	390	1310	779
Laser printout	430	255	865	513
Mixed office paper: flat	380	226	755	449
Mixed office paper: crumpled	110-208	68-122	610	363
Corrugated cardboard	75-100	45-60	525-700	312-416
Boxboard	-	-	837	496
Waste paper	70-90	42-53	215-270	
Metals				
Ferrous cans: whole	150	89	-	-
Ferrous cans: flattened	330	208	405-485	240-289
Aluminum cans: whole	50-75	-	350-430	208-256
Aluminum cans: flattened	175-250	-	350-430	208-256
Mixed food & beverage containers	175	104	-	-
Scrap metal: heavy	4050	2403	-	-
Scrap metal: light	1350	801	-	-
Scrap metal: mixed	1517-1685	900-1000	-	-
Scrap metal: tin	160	95	-	-

MATERIAL	UNCOMPACTED		COMPACTED	
	lbs/cubic yard	kg/cubic metre	lbs/cubic yard	kg/cubic metre
Glass				
Glass containers: whole, bin	500-600	296-356	-	-
Glass containers: flint bottles	500-515	296-305	-	-
Glass containers: Green bottles	550-650	326-385	-	-
Glass containers: Amber bottles	540-550	320-326	-	-
Semi-crushed glass (manually)	100-1080	593-640	-	-
Crushed glass (mechanically, bin)	-	-	1800-1980	1067-1174
Organics				
Food: kitchen waste	800-900	475-534	-	-
Solid fats & liquid fats/ greases	1450-1500	860-890	-	-
Leaves (loose)	250-450	148-237	450-665	267-395
Brush (loose)	250-350	148-208	-	-
Brush (chips)	500	297	-	-
Grass clippings	665-740*	395-439	1050-1110	623-659
Yard waste (mixed)	300-600*	176-356	1037	615
Wood				
Loose dimensional lumber	244	145	-	-
Pallets	286	170	-	-
Sawdust	484	288	-	-
Wood chips	300	298	-	-
Shavings	405	241	-	-
Trimmings	970	377	-	-
Crates	182	108		
Plastics				
PET bottles (whole)	30-45	18-27	515	306
PET bottles (flattened)	-	-	75	44
PET bottles (baled)	-	-	400-515	237-306
HDPE bottles (whole)	25-35	15-21	-	-
HDPE bottles (flattened)	-	-	65	39
HDPE bottles (baled)	-	-	324-400	192-237
Odd plastics	50	30	700	415
Film (baled)	-	-	849	504

MATERIAL	UNCOMPACTED		COMPACTED	
	lbs/cubic yard	kg/cubic metre	lbs/cubic yard	kg/cubic metre
Textiles				
Mixed/scrap textiles	170-300	100-178	480	285
Ash				
Mixed ashes	1096-1400	650-830	-	-
Fly ash	1180-1517	700-900		
Soil/garbage				
Waste soil	3720	2210		
Garbage				
Garbage/ mixed waste	600-800	343-476	1200-1500	700-900

Source: Recycling Council of Ontario, USEPDA Reports, Enviros RIS In-House Reports

TABLE C.2 – METRIC AND IMPERIAL CONVERSIONS

One cubic yard = 0.764 cubic metres
1 kilogram = 2.2 pounds
1 tonne = 1000 kg = 2200 pounds

TABLE C.3 – DENSITY AND WEIGHT OF HOUSEHOLD SPECIAL WASTE

Paint waste:	1.47 kg/ litre
Motor oil/ engine coolant:	1kg/ litre
Propane tanks:	one - 1 lb tank = 9.08 kg
Lead acid batteries (car):	17.9 kg/unit
Lead acid batteries (truck):	6.95 kg/ unit
Lead acid batteries (motorcycle):	4.32 kg/unit
Dry cell/ household batteries:	0.0588 kg/ unit
Motor oil filters:	1.5 lb or 0.68 kg (average weight)
Fire extinguishers:	one-10 lb unit: 4.5 kg
Misc. HSW (excluding motor oil):	1.235 kg/ litre

Source: USEPA Report and Region of Peel, Ontario

TABLE C.4 – WEIGHT OF WHITE GOODS

Appliance	Weight	
	Pounds (lbs)	Kilograms (kg)
Air conditioners (room)	**64.2**	**29.2**
Dishwashers	92	41.8
Dryers (clothes)	130	59.1
Freezers	193	87.7
Microwave ovens	50	22.7
Ranges	181.1	82.3
Refrigerators	267	121.4
Washers (clothes)	177	80.5
Water heaters	131	59.5

Source: USEPA Report

TABLE C.5 –WEIGHT OF DIFFERENT CONTAINERS OF GARBAGE (MIXED WASTE)

Size of Container	Weight (tonnes)	
(cubic yards)	Uncompacted	Compacted
2	0.41	0.82
3	0.61	1.22
4	0.81	1.63
6	1.22	2.44
8	1.63	3.25

Source: Enviros RIS In-House Files

TABLE C.6 –WEIGHTS OF DIFFERENT TRUCKS

Truck Capacity (cubic yards)	Weight (tonnes) Uncompacted
12	0.9
20	4.6-6
25	10.2

Source: Enviros RIS In-House Files

Notes:

- Truck sizes typically range from 12 cubic yards to 25-30 cubic yards
- Payload depends on the number of truck axles, i.e., a truck with two axles can carry more than a truck with one axle.
- A truck typically achieves a 2:1 compaction ratio.

APPENDIX D

Draft Beneficial Use Position, December 2003

APPENDIX D

DRAFT GAP BENEFICIAL USE PRINCIPLES AND RULES

9 DECEMBER, 2003

This paper documents the status of GAP Team discussions regarding the definition of "beneficial use" as of December, 2003. It incorporates various suggestions sent to me by GAP Team members from different parts of the country.

1. Beneficial Use Within GAP

Beneficial use refers to a situation where:

- a material is recovered from the waste stream and
- is directed to a "beneficial use" which is not closed loop recycling.

2. Beneficial Use Within Landfill Boundaries – Criteria to Count as Diversion in GAP

Beneficial use of recovered materials within a landfill site is considered diversion where the following criteria are met:

Criterion #1: A quantity of material that is "separate and identifiable" displaces another type of material that is purchased for a specific use at a landfill
Substituting compost for purchased landfill cover or using glass for road construction instead of aggregate are two examples which should be counted as diversion. Some concern was expressed that this gives municipalities who own their own landfills more diversion options, but this is the reality of the variations among municipalities.

Criterion #2: The material has been processed in some way
This criterion is used in Nova Scotia to distinguish material which can be counted as diversion (although in Nova Scotia it generally applies mostly to C&D material which must be crushed to 6" size). Examples include wood which is chipped or glass which is crushed to a particular size, tires which are shredded, etc. Contaminated soil is not generally a residential waste and is therefore out of the scope of this definition.

Criterion #3: The material must NOT be destined for disposal in the landfill anyway.
Using incinerator ash as alternative cover is likely good landfill management. However, this practice does nothing to encourage diversion or avoid disposal. The ash is double-counted if the alternative daily cover use was considered diversion. The material going to the incinerator has already been counted as disposal.

Criterion #4: Other technical and economic options are not viable
This covers the situation where the municipality could have used the material technically, and also economically, in other applications but chose not to do so.

3. Specific Beneficial Use and Disposal Examples Within GAP

GAP Team discussions on various examples have agreed that:

- **Incinerator ash used as landfill cover** is not diversion, as the material has already been counted once as disposal when it went into the incinerator in the first place.
- **Incinerator ash used as roadbed material or feedstock to new manufacturing** is not counted as diversion because it has already been counted as disposal when it entered the incinerator.
- **Poor quality compost used as final landfill cover** is diversion as this material has been processed already. The amount used should not be greater than if the material were purchased. It may be used at the landfill because paying markets can not be found, or it was the most economical option for the site;
- **Good quality compost used as final landfill cover** is considered diversion given the definition put forward by Ontario that if it could be used at an alternative location, it is legitimate diversion.
- **Crushed glass used for road construction at landfills** is considered "reuse" by some GAP team members (counting towards diversion). It also meets the criterion of having been processed in some way (a requirement to be counted as diversion). It contributes to "landfill conservation" by reserving landfill space.
- **Crushed glass used for cover at landfills** is not considered diversion by the Manitoba Product Stewardship Council when allocating diversion grants to municipalities;
- **Crushed glass as aggregate substitute in construction projects outside landfill** is considered diversion by definitions used in Ontario (up to 15% OPSS) and BC;
- **Shredded tires as road stabilization material within landfill** is considered diversion as the tires have been processed, and the shredded tire material has good engineering and drainage properties for this purpose;
- **Ground wood or mulch used as landscaping material within the landfill** is diversion because the material has been processed[1]
- **Ground wood or mulch to rehabilitate city properties outside the landfill** is considered diversion, even though if the City were to purchase material, it might purchase a smaller amount
- **Ground wood as final cover for landfill** is considered diversion because the material has been processed, and it displaces the need to purchase cover material;
- **Ground wood or mulch for maintenance of city properties outside of landfill** is considered diversion as long as the amount used is the same as when the material is purchased;

[1] Durham Ontario has used large amounts of this material at a rural landfill

- **C&D material used for landfill roads or cover material**. Most or all C&D material is from commercial sources. GAP only addresses material from residential sources therefore this use is not counted as diversion in Residential GAP.

Following a GAP Team meeting on 15th December, 2003, there was agreement among the GAP Team to modify some of the above positions based on additional research, and also feedback from various GAP team members.