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Solid Waste Management: Some Basic Applications

Seminar Proceedings

Solid Waste Management
Report EPS-3-EC-75-3

Environmental Conservation Directorate
September, 1975

SOLID WASTE MANAGEMENT: SOME BASIC APPLICATIONS

Seminar Proceedings

Sponsored by

Environment Canada
and
New Brunswick Department of Fisheries and Environment

Held

May 15 & 16, 1975
Fredericton, New Brunswick

ABSTRACT

These proceedings record verbal presentations by three speakers and the questions and answers following each presentation at a seminar entitled "Solid Waste Management: Some Basic Applications" held at the University of New Brunswick, Fredericton on May 15 & 16, 1975. The seminar was sponsored by the New Brunswick Department of Fisheries and Environment and Environment Canada's Atlantic Regional Office.

The topics were presented by staff of Environment Canada's Solid Waste Management Branch. The subjects were:

1. Dump Closure – Site Conversion
2. Small Sanitary Landfills – Design & Operation
3. Resource Recovery
4. Refuse Collection & Transfer
5. Regional Solid Waste Management Studies, and
6. Regional Refuse Collection, Transfer & Disposal.

The presentations and discussions they generated attempted to focus on the problems and needs of New Brunswick, and are likely to be applicable to all rural areas of Canada.

RÉSUMÉ

Le présent document est un compte rendu des présentations faites par trois orateurs ainsi que des questions et des réponses qui ont suivi chaque présentation lors d'un colloque intitulé "La gestion des déchets solides - Quelques applications de base" qui a eu lieu à l'université du Nouveau-Brunswick, à Fredericton, les 15 et 16 mai 1975. Le colloque était organisé par le ministère des Pêches et de l'Environnement du Nouveau-Brunswick et le bureau régional de l'Atlantique d'Environnement Canada.

Les sujets suivants ont été traités par des représentants de la Direction des déchets solides d'Environnement Canada:

1. Fermeture des dépotoirs – Transformation de l'emplacement
2. Petites décharges sanitaires – Conception et fonctionnement
3. Récupération des ressources
4. Enlèvement et transport des rebuts
5. Études régionales sur la gestion des déchets solides, et
6. Enlèvement, transport et élimination des rebuts à l'échelle régionale.

Les présentations et les entretiens suscités visaient à cerner les problèmes et les besoins du Nouveau-Brunswick, mais pourraient cependant s'appliquer à toutes les zones rurales du Canada.

FOREWORD

Sponsored jointly by Environment New Brunswick and Environment Canada, the two-day seminar ''Solid Waste Management: Some Basic Applications'' was presented by members of Environment Canada's Solid Waste Management Branch.

It was requested at the outset that emphasis in this seminar should be placed, not on highly technical subjects, but, rather, on fundamental, basic activities appropriate to the needs of New Brunswick.

With that request in mind, the subject matter of these proceedings was developed.

TABLE OF CONTENTS

SOLID WASTE MANAGEMENT: SOME BASIC APPLICATIONS

Seminar Proceedings

OPENING REMARKS

Mr. B.B. Barnes
Assistant Deputy Minister, Environment
New Brunswick Department of Fisheries and Environment
Fredericton, New Brunswick

Good morning. I am Brian Barnes. I am with the Province of New Brunswick, in what was the Department of Fisheries and Environment, which will be shortly the Department of the Environment. It is my privilege to welcome you to this two-day seminar on behalf of Environment New Brunswick and Environment Canada who are sponsoring this two-day seminar.

I notice on the printed bulletin that I am allocated fifteen minutes and I can assure you that I don't intend to take anywhere near that length of time. I would note that seminars have been held in the Atlantic Region in the past year and a half, in Halifax, and there was some request, with considerable interest, in having a slightly shorter, more practical seminar to be held in New Brunswick. We hope that the agenda and program that have been laid out today and the speakers you are about to hear will answer that request.

I would note that there are over two hundred solid waste disposal sites in New Brunswick. Unfortunately, a very high percentage of them could probably be called dumps and it is through the efforts of both our agencies that we would hope that in the not too distant future we could say with pride that there are a number, 200 is the right number, of proper solid waste disposal sites in New Brunswick. That requires effort in locating them, deciding what type they should be and most important, proper operation.

I would hope that through this seminar, through literature that is being developed and other efforts of you people and staff of Environment Canada and Environment New Brunswick that we would be able to say that we have proper solid waste disposal sites in New Brunswick, in a very short period.

One thing that concerns me which I have noticed, is the uproar which is created in any municipality whenever word gets out that a sanitary landfill solid waste disposal site, or as a lot of people call it, a dump, is to be located in a new area. Just as soon as word gets out there is a delegation to the City Council or to the Government or to our Department or whatever the proper agency is. I have said on many occasions that if you look at the highway that leads to the site in Fredericton or probably to any other site in New Brunswick you can see why people are concerned. The point is that in addition to making efforts to ensure that the disposal site itself is properly located and properly operated we have the problem that goes with it of transfer of the waste to the site, and I am sure that if any of you go down

the Vanier highway, the backroad to Saint John it is quite obvious from all the litter that is scattered along the side of the road that a solid waste disposal site is located partway down that road.

You can say pretty near the same thing for almost any other site in New Brunswick. In addition to the site itself we are also going to have to devote our attention to the control of the vehicles or the method of transport of the waste to the site.

Now, that subject is not part of this program. It is a little premature but it is a subject that we are going to have to turn our attention to. I'm advised that the City of Fredericton is presently considering a much more stringent bylaw for people who haul garbage for another party, that is the people who make their living hauling waste to the dump, and make a bylaw that is enforceable without having seven police cruisers on the road between the City and the dump site. Perhaps that is the first step in the right direction. We still have the problem to overcome of the private individual, who loads his waste into his trailer and lugs it to the dump on Saturday and doesn't pay too much attention and some of it falls off onto the road. Somehow or other we have to overcome that problem, too. But that, presumably, is a subject for a future seminar.

For this morning, may I express my appreciation for the efforts of Raymond Benoit, and Lawrence Fedoruk for the efforts that they put into arranging this seminar and I am sure that through their efforts, that you will all be much better acquainted with some of the problems in some of the areas of solid waste disposal. Thank you very much.

CHAIRMAN'S OPENING REMARKS

Mr. R.A. Benoit
Solid Waste Engineer
Pollution Control Branch
New Brunswick Department of Fisheries and Environment
Fredericton, New Brunswick

Thank you Brian. My name is Raymond Benoit. I am with the New Brunswick Department of the Environment and I am going to act as your Chairman for today.

The program for this morning, as you can see, includes two sessions. One on dump closure and site conversion. I am sure most of us have had experience at one time or another with closing a dump or changing location. It is not as easy as it may seem. There will be a second presentation this morning on the design of a small sanitary landfill. There will be a question period following each presentation. We will go right ahead on the first talk on dump closure and site conversion. This one is going to be presented by Mr. Bob MacKenzie.

Bob MacKenzie is a Nova Scotian by birth, an Ontarian by inclination, a Chemist by training and a generalist by choice. He received a Masters Degree in Chemistry from Acadia University in 1964. For seven years Bob worked as a research chemist and process chemist for Polymer Corporation and developed pollution control processes related to solid waste recovery. He joined Environment Canada in 1972 and is now responsible for development of technical information and training programs in the solid waste management field in Ottawa.

DUMP CLOSURE - SITE CONVERSION

Mr. R.C. MacKenzie
Solid Waste Chemist
Solid Waste Management Branch
Environmental Protection Service
Environment Canada
Ottawa

WHAT IS A DUMP?

A dump is a waste disposal site where solid wastes are deposited with little or no regard for pollution controls or aesthetics. By definition, then, a dump is *not* a sanitary landfill; it is *not* a modified landfill, both of which are *planned* disposal systems, designed and operated so that adverse environmental effects will be minimized.

A dump is often referred to as an "open dump" because the wastes are generally left uncovered for extended periods of time. Often, neither the existence of the dump nor its use is authorized by any agency nor, in fact, is it supervised in any manner. It just sits there.

Invariably an open dump is also a burning dump. The fire may be spontaneous. More than likely, however, the fire is purposely set in an attempt to reduce the volume of discarded materials or to destroy the food that attracts rodents and insects.

With respect to the location of dump sites, frequently there is little or no attention paid to the environmental suitability of the site. Instead, the controlling factor is the availability of the land at the cheapest price. Consequently every type of typography, ranging from flat meadows to steep ravines and the banks of streams, has been used for open dumping.

The appearance, the ugliness of an open dump is difficult to assess in any but abstract terms. Nevertheless, it is a very real concern.

Open dumps have been cited as the villains in situations involving suspected pollution of surface water and groundwater.

Insects, rodents, birds and animals which frequent an open dump can transmit serious forms of illness to persons living near, or using, a dump.

A very real annoyance of burning dumps is the production of airborne particulates which cause, or aggravate, respiratory problems. Some of these air pollutants can soil clothing and buildings, while others can be toxic. Fires associated with burning dumps are a potential hazard to nearby fields, woodlands and buildings.

END

Really, there is very little that one can say in *favor* of open dumps. Why, then, are they so common?

In the first place a dump satisfies a human need. It provides a place where discards may be deposited.

The existence of a dump oftentimes is evidence that an organized refuse collection system does not exist. Therefore, people are left to their own devices, and usually find a place within a short driving distance from home; but not too close, mind you.

Even where a dump is authorized by a municipality it is often neglected because that portion of public works funds allotted for garbage dispoal is usually minimal, and has always been that way. Consequently, a "better" method of waste disposal usually cannot even be considered as, almost invariably, it will cost more to operate.

So, is there a place for dumps?

Surprisingly, perhaps, the answer should be "yes". Provided it is operated in a "controlled" manner a dump can serve a useful purpose where other methods of solid waste disposal are not practical.

WHY SHOULD THE DUMP BE CLOSED?

Primarily, there are four reasons why a dump should be closed or converted. They are:

1. Legislative
2. Environmental
3. Social
4. Physical

Let's look at each of them in more detail.

Legislative Reasons

Legislative bodies, in other words various levels of government, have used Environmental Protection Acts or Public Health Acts to close off open dumps.

That is fine, in principle, but the enforcement of appropriate regulations must allow for the provision of alternative disposal methods or sites. It is pointless to close an open dump at say, Point A, without providing a landfill at that same place or at another place because the refuse will surely re-appear at Point B, or C or .....

Legislators should recognize that, for example, geological conditions might make it impossible to replace a dump with a sanitary landfill ..... an operation that depends upon a continuous supply of cover material. It is also true that many communities are not financially able to quickly change over to proper volume reduction methods like incineration or shredding.

The purpose of legislation should be to control the spread of open dumps and to control the operation of those which are authorized *until* better methods can be introduced.

Environmental Reasons

There's no doubt about it; an open dump will surely have an effect upon the surrounding environment.

Man has recognized for centuries that proper containment and isolation of his wastes from flies and rodents is one of the best methods to reduce the spread of communicable diseases such as typhoid fever, cholera and tuberculosis. That means an open dump is a pretty unhealthy place.

Dumps are usually open to scavenging. As such, they present a very real threat to people and animals who roam through the dumps due to the presence of sharp fragments of glass, metal and other hazardous objects.

We have mentioned that dumps *could* pollute surface water and groundwater. Usually, it is most difficult to *prove* that the dump is the cause. Even so, suspicion alone is frequently the basis for closure or conversion.

Open burning at dumpsites deserves to be banned. If there is no practical alternative, it should be allowed *only* when weather conditions permit a minimum of annoyance and fire hazard and under strict supervision.

In any refuse burial system, the decomposition of organic matter will produce unpleasant odors. In the case of an open dump, the entire area is exposed. That means that smells can easily be carried on the wind for considerable distances.

The wind can also blow away papers and other loose material. This becomes particularly hazardous when they happen to be on fire.

Social Reasons

No one wants an open dump next to them ..... only, "next" could be anywhere from over the fence to several miles away.

Now, that is probably an understandable reaction. But what is baffling is the reaction that sometimes occurs when attempts are made to introduce *improvements* to the disposal system. The toleration that some people have for unauthorized, clandestine dumps is often replaced by open revolt when it is proposed to close down the dumps and replace them with one central, properly operated, disposal facility.

Any disposal site, including a dump, usually serves a large number of people. Those who live near the site, whether it is a dump, a landfill, or whatever, will object to it because it is too close for comfort.

But are the objections raised by a few people reason enough to move the site? Surely, moving a dump to another location will only antagonize another group of individuals. You might as well put the dump on wheels!

The answer is "no", objections by neighbours should *not* be the sole reason for closing a "dump". Experience has shown that sanitary landfill, incineration, composting and others have all had their share of critics.

There are, however, some very *valid* social reasons for closing or relocating a disposal site, for example

1. urban expansion, which will encompass the site location;
2. the creation of transportation corridors or pipeline routes;
3. the selection of a nearby location for a new airport. This means that birds, attracted to the dump may become a hazard to aircraft.

Physical Reasons

The other reasons for closing a dump are physical, where the site is physically incapable of accepting more waste. This situation, however, rarely happens. More often than not, the wastes are allowed to spill over into adjacent areas or, if things become too crowded, a bulldozer is brought in to pack it down.

PUBLIC RELATIONS

The public has a right to know about any changes that are planned for *their* disposal site. If it is an open dump, chances are a lot of people are using it, from municipal and private collectors to householders and tourists.

On the other hand, the agency responsible for the dump should *want* the public to be informed because their support is necessary.

You must remember that people generally have a negative attitude toward refuse. To many it is something that is unwanted, that is ugly, smelly and disgusting.

So, on one hand we have some people who cannot see why money should be spent on *proper* disposal. On the other hand the agency responsible will be criticized for allowing an undesirable situation, an open dump, to continue. That leaves you walking a tight rope.

Past experience has shown that, generally, whenever a public meeting is held to discuss improvements in a solid waste disposal system two types of people show up.

1. The objectors, who want the dump moved away from them or who will object to the *proposed* location of even a *proper* facility near them.
2. The other group represents the overnight solid waste management experts. They are usually aware of certain concepts, like recycling, but only in a vague way. Normally, their proposals bear little resemblance to practical solutions for any particular situation.

As a result, public meetings have been known to degenerate into shouting matches. The alternative to public meetings is to plan your improvements and then implement them in secret. Then you would announce the new system after it had become an accomplished fact.

This can generate an even greater maelstrom of protests. People assume you have operated in secret because you have something to hide. As a result, there's no way they will trust you.

So what do you do?

First of all, accept the likelihood that objections and criticisms will result no matter what you do.

Secondly, you should carefully plan the *timing* of your public announcements.

And thirdly, carefully organize the *quality* of the information you present.

OK. So what do you want to communicate?

There are several major points that should be stressed.

It should be emphasized that improper operations must be stopped. We have already discussed the reasons why an open, uncontrolled dump is unacceptable.

Therefore, you should make it clear that an improved system is to be introduced. It will have a number of advantages, but at the same time, may also cost the taxpayer more money.

Remember: to properly introduce the system and continue operation at the expected level, the support and cooperation of the public is very essential.

Let's assume you have decided to inform the public right from the start. There are several points that must be kept in mind.

1. The disclosure, the information, must be substantially complete or accusations of deceit may follow if anything is withheld.
2. Rumor must be thwarted by fact. Honesty will frustrate controversy.
3. Simple facts are better than complicated explanations.
4. The facts must be presented in language the public can understand.
5. Anticipate, and then accommodate, special interests.
6. Be aware of local issues and priorities.

7. Remember that solid waste is a "negative" subject. That is, people think
   (a) waste is something that is unwanted; therefore very little time and money should be spent on its management;
   (b) why waste time on good, rational solutions - go ahead and dump it;
   (c) it is a low interest item. At public meetings, only the objectors will likely appear.

Once the decision is made to communicate -- KEEP IT UP! Use progress reports and press releases.

Don't expect opinions and positions to change overnight. After all, garbage is a low interest item. You are competing for attention with other, more glamorous subjects.

Wherever possible, try to do the following:

1. work with responsible individuals and promote yourself and your agency as responsible, too
2. win the cooperation of various social and civic organizations and they, in turn, will reach a larger audience
3. use the mass media -- the press, radio and TV. Try ideas like displays in shopping centers; try using posters and leaflets.
4. make a good impression throughout the implementation stage and follow it up with a continuing high level of service. Try the following:
   (a) keep your equipment clean and well maintained;
   (b) have neat uniforms for personnel;
   (c) post signs that *help* the users rather than telling them what they *cannot* do;
   (d) early in the program, make some major improvements to show your good intentions and then have them publicized.

Now, that probably sounds like a lot of effort so let's emphasize what has usually happened when things were kept in the dark.

If you decide to make your plans and do your work in private and "eventually" announce the conclusions, the timing becomes very important.

In the first place it is virtually impossible to complete a study of this kind without something slipping out. When that happens, people start to get suspicious. And once that happens there may be no way to neutralize their concern when your plans are finally publicized.

If you go this route you might have an easier time of it during the study period but that peace may soon evaporate when the conclusions are publicly announced.

EXTINGUISHING FIRES

Fires burning combustible debris in waste disposal sites in populated areas are both hazardous and obnoxious, and may be difficult and expensive to extinguish.

A variety of fire fighting methods have been experimented with in the past. Factors such as depth of fill, content of the fill, available space and local availability of heavy equipment are known to affect the fire fighting procedure and operations.

The first step to take in fighting a deep seated fire is to isolate the burning fill area by trenching to bedrock or bottom of the fill. In addition, as a precautionary measure, a similar fire break should be constructed around the fill area. The second step is to encourage combustion or to douse it.

Digging "firing" holes, trenching and windrowing are effective methods of aiding combustion of smouldering fill.

The excavation of trenches is usually more successful and less time consuming than digging a number of holes. Parallel trenches are dug to bedrock or the bottom of the fill, thereby allowing direct access to the bottom of the smouldering material. These trenches can be set ablaze and left to burn overnight, causing large amounts of material to be consumed.

The third method involves windrowing of smouldering debris by crawler tractors equipped with buckets and a rake. Windrowing does not rely on the availability of an hydraulic shovel, and produces results similar to the first two methods just described. Windrows are created by pushing material into long parallel piles.

The construction of windrows allows the wind to naturally ventilate the piles and also allows the material to be continuously stoked. Overturned and aerated windrows burn very effectively. The piles are usually able to retain heat as long as they are fed and aerated periodically.

Water which is applied to soak and to douse material should be treated with wetting agents. Wetting liquids prepared specially for fire fighting should be used. These wetting agents increase the fire extinguishing action of water thus making a little water go a long way. The user is referred to the Canadian Underwriter's Association and the local fire protection equipment distributors for further information on the various types of wetting agents available on the market.

One final word of caution: When fires burn underground in a dump, voids are created when the combustible material is consumed. That means the soil or material above the void could cave in. This is particularly hazardous to operators of heavy equipment. So, be cautious. A dump that's been burned could become a trap later on when someone tries to use it as a storage area or a park.

RODENT EXTERMINATION

The subject of rodent extermination is one which will likely be required in any dump closing or conversion operation. It is recommended that *only* professional exterminators be employed for this task, people who have knowledge of the proper handling of poisons.

General Information

A dump may harbor substantial numbers of rats which, in some circumstances, travel to nearby fields or housing when the incoming refuse (their food supply) is cut off. The extent of the problem has to be estimated and controlled accordingly -- it is not always necessary that rat control methods be applied when a dump is closed. There may not be any rats. Very rarely, mice, cockroaches, or flies may have populations which would justify terminal control, but these circumstances occur infrequently enough so that control procedures for them are not discussed here.

Estimation of Rat Populations

Simple and reliable field estimates of rat numbers, taken before and after poisoning, are hard to arrive at. Really "scientific" methods require so much preparation as to be impractical for dump closings, and some simple estimate based on rat signs and aided by judgment usually suffices. One approach to "guesstimating" numbers is to drive out near the dump face at night, turn out the car lights and remain absolutely quiet for half an hour. Noises of moving rats give some idea of their numbers. After poisoning operations, though, things should be pretty quiet.

Rats usually are not uniformly distributed all over a dump. Often they will not be numerous in the old area where dumping has ceased; there is harborage there but little food. They may not be in

the immediate dumping areas either, because their harborage would be disturbed there. Look for burrows, runs, and droppings on the less frequently disturbed banks, fields, and dump surface immediately surrounding the dump face. Of course, dumping may be quite scattered over the dump, and in this circumstance the rat population may very well be scattered too. This means that your work will be just that much harder.

Time Schedule

Once dumping of refuse has been stopped, the rodent extermination program should begin.

Signs should be posted at the roadway entrance, the main gate, and on the perimeter of the site at 200 foot intervals, to indicate that poisons are being used. In the interests of public safety, the operator of the dump should provide daily supervision of the site during the period that dangerous and poisonous chemicals are being used. The refuse should not be covered until the rodent extermination program is complete.

The rodent extermination should begin by first establishing feeding stations for the rats. This can be done by setting up baiting stations around the dump and feeding the rats a variety of non-poisonous foods for two to three weeks. This procedure keeps the rats at the dump, establishes their food preferences, enables a determination of their approximate numbers, and establishes locations where they congregate, thus allowing the establishment of protected poison feeding stations on their runways.

The next step is to remove all the non-poisonous food not eaten by the rats and to set up bait-feeding on the established runways with "FAST ACTING POISON" and foods for which the rats have shown a preference. This phase should require two or three days after which the remaining food and "FAST ACTING POISON" can be removed. Now the bait-feeding stations should be loaded with anti-coagulant poisons. The use of these types of poisons should continue for two to four weeks. After this period, the grading, compaction, and covering of the refuse can begin.

After the final cover has been applied, the site should be inspected for new burrows. Any new burrows should be gassed with poison gas, then baited with anti-coagulant poisons. Also, bait-feeding stations should be placed and maintained around the perimeter of the site. These stations should be inspected regularly to see if there is any further activity.

As we mentioned earlier, rodent extermination might best be left in the hands of experts. If a rodent exterminator is contracted to do the job, a written contract for at least one year should be provided for any required follow up.

DUMP CLOSURE PROCEDURES

General

The closure of a site can be considered in four stages

1. Planning
2. Education
3. Implementation
4. Maintenance

The first step in any closure program must be to assess the problem and PLAN appropriately to ensure that the closure proceeds smoothly, the environment is protected and that no harm comes to the people living nearby.

Once the assessment and planning stage is completed it is necessary to EDUCATE the general public for reasons which we have already discussed. But remember: it is equally important to post adequate information and warning to prevent accidents and poisoning during the rodent extermination phase.

The next step in the closure procedure is to IMPLEMENT the plan. This includes the start up of the new site, a rodent extermination program, grading compacting and covering of the old site. This is followed by seeding of the site with appropriate vegetation to maintain the integrity of the cover material.

The final general requirement of a site closure procedure is to MAINTAIN it for a period of time, which is likely to be one or two years at least.

Planning

The plan for the closure of an open dump should address itself to include the following:

(1) assess the problem
(2) choose an alternate disposal site
(3) choose the method to be utilized in closing the site
(4) assess the availability of satisfactory cover material & top soil
(5) organize a rodent extermination program
(6) choose a method to be used to extinguish fires
(7) choose the method to be used to control access
(8) arrange the posting of appropriate signs
(9) consider the ultimate use of the closed site
(10) decide upon the final grade of the closed site
(11) include an adequate buffer zone surrounding the buried refuse
(12) choose the equipment to be used and consider its availability for the physical closing of the site
(13) choose the appropriate time of year to close the site
(14) estimate the cost of actually closing the site
(15) estimate the cost of maintaining the site for a period of time following closure
(16) include the cost of educating the local citizens

Once the assessment and planning stage is completed, and all parties concerned feel that adequate safeguards have been included, it is then necessary to EDUCATE the general public as to the intentions of the site owners.

Not only is it necessary to indicate to people where they will be taking their garbage in future, but it is also very important that you receive and assess their feedback to the program as there may be some very important considerations that have been overlooked in the planning stage. It is difficult to estimate just what length of time should be used to educate the public, or what form the education should take, but it is suggested that the minimum requirements would be three consecutive weeks' notification of the site owner's intentions in a local newspaper which has general circulation in the area served by the site.

Means of education, in addition to the use of the news media, may be considered necessary, and would be encouraged, but these will naturally be dictated by the characteristics and complexity of the local situation.

Education

The closure of a disposal site could not be carried out successfully without first educating the public. No matter what action one takes at the disposal locations, it is impossible to stop people from producing garbage. It is, therefore, mandatory to let them know of the planned closure and the alternate refuse disposal site. The education of the public will not only reduce confusion and hopefully prevent harm from coming to someone, but it will also reduce closure costs, as there will not be the extensive indiscriminate dumping at the gate that there would be if no education program was implemented.

As was previously stated, the education program can take many forms, from newspaper ads, T.V. and radio coverage, to public meetings. The methods which are used are not important as long as they are effective in reaching the public. There may be some constructive criticism from the public which deserves some thought. As part of the education program, the site owners should always be prepared for feedback from the public. There may even be some suggestions which will save money or time.

Implementation

There is a certain sequence of operations that must be followed in closing off a dump site. The following sequence is self-explanatory in as much as it is obvious that the new site location must be prepared before the refuse can be diverted from the old dump to the new landfill, and it is common sense to put up signs indicating the use of poisons with which to exterminate rodents and insects. Once the rodents have been exterminated, the refuse may be graded, compacted, and covered with a minimum of two feet of fill. Note that if the site has been operated as a landfill, the amount of grading, compacting, and covering will be minimal. The soil should be immediately seeded to limit scouring of the soil and limit infiltration of water into the refuse.

After having provided for acceptable alternative disposal and other needed support services and materials, and having obtained the necessary public understanding and support, we can begin the actual closing and restoration of the dump. It is important to keep in mind not only *what is to be done* but also the *sequence of activities* and even the *timetable of events* are important. Otherwise, eliminating one problem may create one or two others.

A Typical Sequence of Operations Follows:

1. Fence or otherwise restrict unauthorized access
2. Place necessary informational signs
3. Assign a responsible manager to the site
4. Stop the burning
5. Stop the scavenging
6. Stop the immediately preventable or controllable water pollution
7. Close the dump to incoming refuse, or establish a specific spot on the dump for sanitary landfill operation during closing
8. Control insects and rodents as the need indicates. Usually rats are the principal problem to consider.
9. Provide necessary drainage
10. Establish grades
11. Clean up the junk, compact and cover
12. Seed the area or otherwise prepare it for final use
13. Maintain the cleanliness of the site

Some mistakes or common inadequacies are:

1. Underestimation of the increase in volume of refuse at the dump which will occur when burning stops;

2. Problems of policing the area because some individuals persist in dumping there after the dump is closed;
3. Movement of rats to nearby fields or housing if poisoning is needed and is not done; or is not done within a week after dumping is stopped;
4. Occasional difficulty in stopping the dump fires, particularly if the burning has carried underground;
5. Hazards to equipment operators when putting out fires, through caving-in of burned-out voids.

Maintenance

The final general requirement of a site closure procedure is to MAINTAIN it for a period of time after the closure activities have ceased. This is necessary as several things may happen in the initial years after closure which may require periodic attention. For instance, due to differential settling of the garbage, there may be areas which will require additional fill to bring the site up to grade. Secondly, sloped areas may scour from rain or spring runoff. Certain areas may have to be revegetated because the first plants did not take.

It is advisable to prohibit the construction of any building on a closed dump site because it makes a poor foundation.

Playgrounds, golf courses, and similar recreational facilities do not normally have to support appreciable concentrated loads, and converted dumps are often used for these purposes, but they still require careful planning. Maintenance costs may be greater for recreational areas constructed on dumps than on natural ground because of excessive and irregular settling and possible cracking of the cover material.

Furthermore, gas from the decomposing waste may accumulate in explosive concentrations in or beneath buildings constructed on or adjacent to the fill.

There are decomposition gases generated within the disposal site which should be controlled on-site. They should not be allowed to migrate laterally from the land disposal site. The control of gas movement should be done either by making use of the natural soil and hydrologic and geologic conditions of the site or controlling gas permeability.

The following techniques or methods for gas movement control have been used or are considered possible.

Vents. When vents are employed, they should consist of gravel vents or gravel-filled trenches.

Barriers. Barriers formed by compacted clay can be used to control the movement of gases. The clay will be installed as a liner in an excavation or be installed as a curtain wall to block underground gas flow. When the bottom and perimeter of the disposal site have been lined with impermeable material, the cover material should consist of permeable material in order to prevent buildup of dangerous concentrations of gases.

Vent Pipes. Vent pipes which are inserted through a relatively impermeable top cover can be employed. Collecting laterals placed in shallow gravel trenches within or on top of the waste will be connected to vertical risers. Vertical risers should not be located near buildings, but if this is unavoidable, they should discharge above the roof line.

The decomposition gases should be vented into the atmosphere directly through the cover material, cut-off trenches, or forced ventilation systems in such a way that they do not become concentrated in explosive quantities. Methane is highly explosive in concentrations of 5-15% when in the presence of oxygen.

Closure Methods

There are two basic site closure procedures currently in use. They are the trench method and the area method. Occasionally the ramp or bank type of method is used. This is a modified area method.

All site closure methods have several common operations. These operations are:

(a) the gathering of all waste into one area
(b) the compacting of the waste to the smallest volume by adequate equipment
(c) the grading of the compacted refuse
(d) the covering of the compacted and graded refuse with a minimum of two feet of a suitable, compacted cover material
(e) the addition of a suitable top soil
(f) the seeding or sodding of the top soil to minimize scouring and erosion.

Trench Method

In the trench method, wastes are spread in thin layers in an excavation, compacted, and then covered with the excavated soil. This achieves maximum density and minimum settlement. The cover material should be compacted to keep flies in and rats out, and it should be graded to keep surface water from ponding. The bottom of the trench should be kept above the level of high groundwater.

It is appropriate to point out at this juncture that a study of the effect of covering refuse with soil showed that hatched flies emerged through as much as 5 feet of uncompacted soil. On the other hand only 6 inches of compacted cover was sufficient to prevent fly emergence.

Area Method

The area method also involves spreading the wastes in thin layers, compacting it, and then covering it with a minimum of 2 feet of compacted soil. If the solid waste is spread over a large area, it must be consolidated and compacted to reduce the amount of settlement and cover material required. The cover material must be graded to avoid ponding of surface water. A modification of this method is used to close bank-type dumps.

Wetland Method

If the dump is in a marshland or an area where the groundwater or surface waters have been contaminated, remedial action should be taken by removing the solid waste from the water or treating the water. The latter step is normally not feasible because of the difficulty in collecting and treating contaminated water. The solid waste and water can be separated by diverting the flow of water or by removing the solid waste from the watercourse. If necessary, surface streams may be relocated and the groundwater level lowered, but it is often more economical to remove the solid waste from the stream using draglines. Removal of old solid waste usually produces very unpleasant odors, so workmen may have to wear gas masks.

The solid waste removed from the water should not be allowed to create new problems. Since most marshes are underlaid by a blanket or a layer of relatively impervious silt, it is often feasible to construct an impervious berm around the perimeter of the new site. The berm should be keyed to the underlying layer and constructed higher than the outside water level. Another device is to build a mat to serve as an operating platform for a dragline as well as the foundation for the excavated solid waste that will finally be covered with soil. Relatively inert materials such as rocks, soil, broken concrete, or demolition debris may be used for this purpose.

Cover Material

Cover material should be selected according to its ability to perform the following functions: (1) limit the access of vermin to the solid waste; (2) control moisture entering the fill; (3) control the movement of gas from the decomposing waste; (4) provide a pleasing appearance and control blowing paper; (5) support vegetation.

Not all soil types perform these functions equally well. While the soil is usually selected from the types available nearby, consideration needs to be given to its suitability before using it as cover material.

The depth of the cover material depends on the use planned for the closed dump, as well as the soil type. Usually 2 feet of earth is sufficient, and it should be compacted and graded. Proper grading is important since it prevents excessive soil erosion and ponding. Ponding tends to infiltrate and saturate the fill, resulting in water pollution.

To further reduce erosion, the area should be seeded with grass or other vegetation. Two feet of soil is usually sufficient for grass, but more is necessary for shrubs and trees.

DUMP CONVERSION PROCEDURES

The general requirements of closure of a disposal site have been stated. However, one of the most common occurrences, at least in recent years, has been the conversion of a dump to a landfill. Rather than taking specific examples of dumps or landfill closure, it would be more advantageous to consider conversion of dumps to landfills, as really just the final step in conversion.

In any conversion to a landfill, where there is a rodent population inhabiting the old dump, it will be necessary to go through a rodent extermination program. As the public will still be using the dump, conversion will have to take place in stages. A new area for disposal will first have to be established on site using sanitary landfill techniques. This will preclude rats infesting this section. The other part of the dump may then be fenced off and the rodent extermination program implemented. Extreme care must be exercised in the design of this type of program to ensure the death of the rodents. As before, signs will be required to educate the public.

Conversion to Trench Operation

Where a dump is being operated in an area which has a low watertable and good sandy soils, conversion to a trench is the easiest to accomplish. After digging a trench, the refuse is dumped into it, compacted and covered. The cover material should be graded to prevent ponding of surface waters. From then on, it is just a matter of digging more trenches as they are needed. The development of the trenches should be planned so as to make the most efficient use of the land available. Land which has been used should be staked so that one does not end up re-excavating the garbage.

Conversion to Area Method

This method is used where a high watertable prevents excavation of trenches. The soil cover may be hauled in or may be excavated from the toe of the working face. First, a berm is constructed against which the refuse is placed. The refuse is compacted, and covered, the slope of the face being no more then 30 degrees. Cells can then be constructed on this slope as more refuse is deposited.

Conversion to Bank Method

A landfill can be operated in this type of situation, but, all too often, there is a creek or a river at the bottom of the bank which makes access to the bottom somewhat difficult. Initially, let's

consider the case where there is not a water course at the bottom. The next section deals with dump conversion when the dump has been operated in water. Basically, conversion from a bank type dump to a bank type landfill entails simply the restructuring of the bank to a thirty degree or less slope, and establishing the cellular structure on that slope. It is essentially the same as the area method. The area method can be utilized with more than one lift and usually is, whereas the bank method usually just extends the banked contour with a series of cells radiating outward.

Conversion of Dumps in Wetlands

The operation of dumps in wetlands has been a common practice which has gone unheeded until the recent days of environmental quality control. This type of dump has usually developed as an uncontrolled site in those areas which have a high water table and clay soils. The method of conversion, in this case, is a very simple operation that basically relieves the environment of uncontrolled contamination. The waste is first removed and then separated from the water by placement of a mat of impervious soil that reaches above the high water table. Another means of separation of the waste from the water can be achieved by diverting the flow of water or, if necessary, by lowering the ground water level. If the water table or other water problems are such that placement of inert, impermeable fill would be economically unfeasible, the alternative is to remove the waste material from the site and place it in a suitable, certified waste disposal site.

WHAT SHOULD REPLACE THE DUMP?

Whatever disposal method or system is used to replace a dump, or a network of dumps, the replacement should be:

Properly planned
Properly developed
and Properly operated.

Invariably, it will be more expensive.

It should, therefore, be economically viable while achieving social acceptance.

The choice of the "other method" will depend upon many factors, including:

Population to be served
Ability to pay the increased costs
Level of service desired
The other elements of the system

The decision to go ahead with a new system or method will be a political decision. It should be based on professional advice.

Rarely will a dump be replaced with anything more sophisticated than a landfill. However, alternatives should be investigated and not discounted without discussion.

Other Components

Whatever changes are made, whatever new disposal method or site is chosen, the choice must be considered in light of other system components.

Dumps arise out of a need for a proper collection service. This means that a thorough examination of the existing collection practices is required, and the introduction of improvements if necessary, before any alternative disposal method will achieve the desired degree of success.

If the dump closure or conversion is due to the introduction of a regional solid waste management scheme, then the following question should be asked "Can the existing site be used for any facility within the system?". In other words can the site serve as a transfer station or be used for storage?

In some rural areas, open dumps have been replaced with large collection boxes, either the roll-off type or the front end load type. The boxes are placed on the closed dump site for the simple reason that people have been using the site for years and therefore, to move the site would involve changing old habits.

QUESTION PERIOD: DUMP CLOSURE - SITE CONVERSION

Question: **(unidentified)** In a trench method dump where you compact your cover material, how many years would you give until you go back to it? To re-trench it? In other words, the dumped refuse will it be decomposed or retrenched?

Comment: **(Mr. MacKenzie)** I am not quite sure what you mean by retrenching. Are you going to dig into the old garbage?

Answer: **(unidentified)** Yes.

Question: **(Mr. MacKenzie)** Why would you want to do that?

Answer: **(unidentified)** For lack of another site.

Comment: **(Mr. MacKenzie)** The impression that I have is that it is kind of a "no-no". But at the same time the actual answer to your question will probably come from Ted Rattray's discussion later on where he is going to be talking about leachate formation and decomposition. There have been places, I recall an example in the States somewhere, where they went back and dug into an old refuse disposal site and they could take out newspapers that were 30 years old and read them.

Comment: **(Mr. T. Rattray)** Even under the best conditions I don't think you will be alive to do it. It will be long after you are gone, before you will be able to go back.

Question: **(unidentified)** Does Environment Canada have any funds available for dump closure?

Answer: **(Mr. MacKenzie)** You had to ask didn't you?

Comment: **(unidentified)** We've got no funds to do it; we can't improve our dumps.

Answer: **(Mr. MacKenzie)** Well, in a way it is rather unfortunate. We're in a situation where we are providing basically support services, where one of the areas that we cover is called technology development. Technology development is primarily concerned with assisting in the development of new or improved disposal systems and as a general rule we shy away from any assistance to a municipality to go ahead and just close off a dump or operate a sanitary landfill. In the first place, it tends to make us unpopular with the provincial governments and secondly, obviously if we did it for one then we would have to do it for any number of other communities in the country. So, I am afraid the answer to your question, that is, if I understand your question, the answer is "no we don't do that". On the other hand, if what you were going to replace that dump with was something that was unique or even if it was something that was old but you are working in a unique situation for example, we can take established incineration or other methods and put them up North, where you really

don't know what is going to happen, in that case, you are into a new situation which we might be prepared to fund and to study. But, if you are into what I think you are, I think that funding from us would not likely occur. You didn't like that answer, I know.

Comment: **(unidentified)** It's what I expected.

Comment: **(unidentified)** You will have to pardon me, I got in late, but all I can see here is that you're talking about a dump?

Answer: **(Mr. MacKenzie)** Right.

Question: **(unidentified)** Are we still assuming people are going to use dumps or act civilized, and start using sanitary landfills?

Answer: **(Mr. MacKenzie)** The whole purpose of this seminar is, first of all, not get sophisticated. We are not going to lay heat recovery incineration on you. What we are saying is that probably for quite some time to come the most satisfactory and inexpensive method of proper solid waste disposal is a sanitary landfill. A sanitary landfill is going to get a lot of attention in the next hour and this afternoon. But at the same time the purpose of this lecture is to tell you that the most common method of doing things now is an open dump, and an open dump is unacceptable. But an open dump can be converted to something that is acceptable, something that resembles a sanitary landfill. It may not be a sanitary landfill, by definition, where a sanitary landfill is one where the refuse is covered with so much soil everyday. There are things like modified landfills where you can cover the waste, say, once a week, but even that is better than an open dump. So, we are not praising open dumps at all. We are saying "let's close them but we don't have to go to something that is sophisticated, that is expensive, and still get an improvement". Did I answer your question?

Comment: **(unidentified)** Yes. That part. Now you mentionned something about moving North. You were saying take the garbage to a northern area?

Answer: **(Mr. MacKenzie)** No. I was simply trying to illustrate the fact that in the Northwest Territories, the Yukon, where you have permafrost problems, you just can't dig into the ground. They have solid waste disposal problems too and they are far worse than they are down here. Perhaps not in volume, but in terms of the fact, that there is very little you can do to it. What I'm trying to say is that we would be in a position or would consider the funding of systems, improved systems to dispose of the waste in the northern areas of the country as opposed to coming in and assisting every municipality in southern Canada who say, "we need money, we have a dump and we want to do something about it." We are not going to be doing that, but we are into doing experimental, technology development types of projects which look at improved disposal methods.

Question: **(unidentified)** You are approving some experimental things? How do we get in on this? If we wanted to do something rather than dig a trench and dump our garbage, we obviously cannot afford to do it in a small village. If we were to request funding, we would gladly be guinea pigs if you would like to do some experimental research on ...

Answer: **(Mr. MacKenzie)** Ok. I'll give you the standard civil service reply. We are not interested in interfering with provincial-municipal relationships. At the same time, we have across the country, regional offices, and we have one in Halifax. This man

right there, Lawrence Fedoruk, is representing the Atlantic Regional Office, and for eight cents, you can send him a letter.

Comment: **(unidentified)** If it will get there.

Answer: **(Mr. MacKenzie)** Don't laugh I heard a guy say that the postal system in Canada was so deplorable that he is still getting his Life Magazine. Seriously, what I would recommend that you do, is write to our Regional Office with your proposal, and let them decide then whether they can do it internally or whether they would then get in touch with us. We are basically a resource group. Any contact with Environment Canada, anywhere in the country, should go through the Regional Offices. They are there, hopefully, to solve the problem right there on the spot.

Comment: **(unidentified)** I'll tell them you sent me. Also, you said that garbage should be well compacted. Is there a large variety of commercial compactors? Shredders?

Answer: **(Mr. MacKenzie)** Are you going to be around here for a while? While we are talking about sanitary landfill one of the things that we will be talking about is the equipment that is used on the site. Basically what you are talking about is a bulldozer and that kind of thing. A tractor, anything you can get your hands on. That's generally what is done on a dump site or a landfill.

Question: **(unidentified)** There is no great new scientific discoveries on how to go about it?

Answer: **(Mr. MacKenzie)** I wouldn't say that. I think that there are a lot of pieces of equipment, that there are a lot of developments which may not have been developed specifically for garbage. They may have been developed for something else and then applied to garbage, pulled off the shelf. But at least that's new.

Question: **(unidentified)** What's the approximate cost per capita for closing a dump?

Answer: **(Mr. MacKenzie)** I have no idea. I don't even want to get into that because, first of all, in a dump operation, a dump is operated by a municipality. A municipality has a bulldozer or something. That bulldozer is used on the dump. But it is also used to plow roads, to haul stuck trucks and who knows what else. Even in their balance sheet you can't pull out what cost of operating that bulldozer is specific to operating a dump.

Question: **(unidentified)** No, I mean to close the dump.

Answer: **(Mr. MacKenzie)** Again, I don't know.

Question: **(unidentified)** For a small community would you estimate $2,000, $20,000, $200,000?

Answer: **(Mr. MacKenzie)** I don't know. First of all, I'll plead ignorant and secondly even if I'd heard figures, I don't think I would be prepared to repeat them, because they've proven in the past to be quite unreliable. Any figures that one hears on these sorts of things generally are quite unreliable.

Question: **(unidentified)** But how is a community to make a decision, when they should be closing out their dump, if they can't find out what it's going to cost them, two, two-hundred thousand?

Answer: **(Mr. MacKenzie)** Well, the only thing that I can suggest is, first of all, to call in somebody who makes a living doing this sort of thing and there are lots of people around, lots of consultants who are into the solid waste management game. I'm sure

there are probably people here in the audience who have had some experience with that very problem.

Question: **(unidentified)** Would it be possible probably that the Department of Highways could help us?

Answer: **(Mr. MacKenzie)** That's between you and the man from the Department of Highways. Did I answer your question? Not satisfactorily, I know. I would just warn you to be very careful of any published figures that you see on either the operation of dumps or the operation of landfills, or even the closing off of dumps. It's usually a site-by-site thing. Your cost can be considerably different from anybody else. Just take for example, the soil. Supposing that suitable soil is not available, on the site or near the site, then you may have an enormous transportation cost involved, that somebody else wouldn't because he's got it right there beside him. So you're going to have to take each of those factors and look into it.

Question: **(unidentified)** What has been the experience in utilizing old pits, old gravel pits, particularly?

Answer: **(Mr. MacKenzie)** Old gravel pits, in particular, are, from what I understand, bad news. There are certain types of quarries and pits which, because of the nature of the rock that you're working in, are quite impermeable, and therefore are reasonably safe. But there are other types such as gravel pits which again, from what I understand, can be very bad simply because of the permeability of them and because you may very well be into a water recharge area. We're going to get into that a little later on. Perhaps not in detail, I don't know whether Ted is going to. But we are going to touch on that subject. My feeling is stay away from gravel pits unless you really understand the geology associated with them.

SMALL SANITARY LANDFILLS: DESIGN

Mr. R.C. MacKenzie

HYDROLOGY AND CLIMATOLOGY

A major consideration in selecting the site for a sanitary landfill and in designing it is the hydrology of the area. To a large extent, hydrology will determine whether the formation of leachate will produce a water pollution problem.

When solid wastes are placed in a sanitary landfill, they may vary tremendously with regard to moisture content.

In general, the moisture content of mixed solid waste generated by a community ranges from 20 to 30 percent by weight. In this general range, the moisture alone should not produce leachate provided the solid waste is fairly well mixed and has been well compacted. The water that results from decomposition of the relatively small amounts of intermixed food wastes and other moist, readily degradable organics can be absorbed by the comparatively large amounts of paper and other dry components present.

Leachate is not produced until all of the sanitary landfill or a sizable portion of it becomes saturated by water entering it from outside. For this reason, it is extremely important that a study of the site hydrology be made. Precipitation, surface runoff characteristics, evapo-transpiration, and the location and movement of groundwater with relation to the solid waste are the major factors that should be considered.

Surface Water

Surface water that infiltrates the cover soil and enters the underlying solid waste can increase the rate of waste decomposition and eventually cause leachate to leave the solid waste and create water pollution problems. Unless rapid decomposition is planned and the sanitary landfill is so designed that leachate is collected and treated, as much surface water as is practicable should be kept from entering the fill.

The permeability of a soil is the measure of the ease or difficulty with which water can pass through it. This is greatly affected by the texture, gradation, and structure of the soil and the degree to which it has been compacted. Coarse grained soils (gravels and sands) are usually much more permeable than fine grained soils (silts and clays). However, small amounts of silts and clays (fines) in a coarse grained soil may greatly decrease permeability while cracks in fine grained soils may do the opposite.

Groundwater

Groundwater is water that is just beneath the land surface in many parts of the country and is on the surface at many springs, lakes, and marshes.

Because the conditions affecting groundwater occurrence are so complex, it is essential that the sanitary landfill site investigation include an evaluation by a qualified groundwater hydrologist. In order to determine if leachate will produce a subsurface pollution problem, it is essential that the quality of the groundwater be established and that the aquifer's flow rate and direction be determined. The groundwater hydrologist should also determine whether the aquifer is in a discharge or recharge area. In a discharge area, water leaves the aquifer and emerges through the ground surface as a spring. In recharge areas, water infiltrates the ground and enters the aquifer. Lakes, streams, and rivers may serve

as recharge or discharge areas, or both, depending on the surrounding groundwater level and geologic conditions.

Climatology

Wind, rain, and temperature directly affect sanitary landfill design and operation. Windy sites need to have litter fences at the operating area and personnel to clean up the area at the end of the day. Such sites can also be very dusty when the soil dries, and this may irritate people living or working nearby. Trees planted on the perimeter of a sanitary landfill help keep dust and litter within the site. Water sprinkling or the use of other dust palliatives are often necessary along haul roads constructed of soil, crushed stone, or gravel.

The effect of rain that infiltrates the sanitary landfill and influences solid waste decomposition has been discussed previously. Rain can also cause operational problems; many wet soils are difficult to spread and compact, and traffic over such soils is impeded.

Freezing temperatures may also cause problems. If the frost line is more than 6 inches below the ground surface, cover material may be difficult to obtain. A crawler dozer equipped with a ripper may be required, or it may be necessary to stockpile cover soil and protect it from freezing. A well-drained soil is more easily worked in freezing weather than one that is poorly drained.

SOILS AND GEOLOGY

A study of the soils and geologic conditions of any area in which a sanitary landfill may be located is essential to understanding how its construction might affect the environment. The study should outline the limitations that soils and geologic conditions impose on safe, efficient design and operation.

A comprehensive study identifies and describes the soils present, their variation, and their distribution. It describes the physical and chemical properties of bedrock, particularly as it may relate to the movement of water and gas. Permeability and workability are essential elements of the soil evaluation.

Soil Cover

The striking visual difference between a dump and a sanitary landfill is the use of soil cover at the latter. Its compacted solid waste is fully enclosed within a compacted earth layer at the end of each operating day, or more often if necessary.

The cover material is intended to perform many functions at a sanitary landfill (Table 1); ideally, the soil available at the site should be capable of performing all of them.

TABLE 1
Suitability of General Soil Types as Cover Material

Prevent rodents from burrowing or tunneling
Keep flies from emerging
Minimize moisture entering fill
Minimize landfill gas venting through cover
Provide pleasing appearance and control blowing paper
Grow vegetation
Be permeable for venting decomposition gas

Many soils, when suitably compacted, have a low permeability, will not shrink, and can be used to control moisture that might otherwise enter the solid waste and produce leachate.

Control of gas movement is also an essential function of the cover material. Depending on anticipated use of the completed landfill and the surrounding land, landfill gases can be either blocked by or vented through the cover material.

The soil cover often serves as a road bed for collection vehicles moving to and from the operating area of the fill. When it is, it should be serviceable under all weather conditions. In wet weather, most clay soils are soft and slippery.

In general, soil used to cover the final lift should be capable of growing vegetation. It should, therefore, contain adequate nutrients and have a large moisture-storage capacity. A minimum compacted thickness of 2 feet is recommended.

Practically the only soils that can be ruled out for use as cover material are peat and highly organic soils. Peat is an earthy soil (usually brown to black) and is composed largely of partially decomposed plant matter. Peat is virtually impossible to compact, whether wet or dry. Highly organic soils include sands, silts, and clays that contain at least 20 percent organic matter. They are usually very dark, have an earthy odour when freshly turned, and often contain fragments of decomposing vegetable matter. They are very difficult to compact, are normally very sticky, and can vary extremely in their moisture content.

Many soils contain stones and boulders of varying sizes, especially those in glaciated areas. The use of soils with boulders that hinder compaction should be avoided.

Land Forms

A sanitary landfill can be constructed on virtually any terrain, but some land forms require that extensive site improvements be made and expensive operational techniques followed. Flat or gently rolling land not subject to flooding is best, but this type is also highly desirable for farming and industrial parks, and this drives up the purchase price.

Depressions, such as canyons and ravines, are more efficient than flat areas from a land use standpoint since they can hold more solid waste per acre. Cover material may, however, have to be hauled in from surrounding areas. Depressions usually result when surface waters run off and erode the soil and rock. By their nature, they require special measures to keep surface waters from inundating the fill.

There are also numerous man-made topographic features scattered over the country - strip mines, worked-out stone and clay quarries, open pit mines, and sand and gravel pits. In most cases, these abandoned depressions are useless, dangerous eyesores. Many of them could be safely and economically reclaimed by utilizing them as sanitary landfills. Clay pits, for example, are located in most impermeable formations, which are natural barriers to gas and water movement. Abandoned strip mines also are naturally suited for use as sanitary landfills. Abandoned limestone, sandstone, siltstone, and granite, quarries and open pit mines generally require more extensive improvements because they are in permeable or often open-fractured formations. The pollution potential of sand and gravel pits is great, and worked-out pits consequently require extensive investigation and probably expensive improvements to control gas movement and water pollution.

Marsh and tidal lands may also be filled, but they are less desirable from an ecological point of view. They have little value as real estate, but possess considerable ecological value as nesting and feeding grounds for wildlife. Filling of such areas requires, however, the permanent lowering of the groundwater or the raising of the ground surface to keep organic and soluble solid waste from being deposited in standing water. Roads for collection vehicles are also needed, and cover material generally has to be hauled in.

SANITARY LANDFILL DESIGN

The designing of a sanitary landfill calls for developing a detailed description and plans that outline the steps to be taken to provide for the safe, efficient disposal of the quantities and types of solid wastes that are expected to be received. The designer outlines volume requirements, site improvements (clearing of the land, construction of roadways and buildings, fencing utilities) and all the equipment necessary for day-to-day operations of the specific landfilling method involved. He also provides for controlling water pollution and the movement of decomposition gas. The sanitary landfill designer should also recommend a specific use of the site after landfilling is completed. Finally, he should determine capital costs and projected operating expenditures for the estimated life of the project.

Volume Requirements

If the rate at which solid wastes are collected and the capacity of the proposed site are known, its useful life can be estimated. The ratio of solid waste to cover material volume usually ranges between 4:1 and 3:1; it is, however, influenced by the thickness of the cover used and cell configuration.

The number of tons to be disposed of at a proposed sanitary landfill can be estimated from data recorded when solid wastes are delivered to disposal sites. The daily volume of compacted solid waste can then be easily determined for a large community or for a small community. The volume of soil required to cover each day's waste is then estimated by using the appropriate solid waste to cover ratio.

Site Improvements

The plan for a sanitary landfill should prescribe how the site will be improved to provide an orderly and sanitary operation. This may simply involve the clearing of shrubs, trees, and other obstacles that could hinder vehicle travel and landfilling operations or it could involve the construction of buildings, roads, and utilities.

Clearing. Trees and brush that hinder landfill equipment or collection vehicles must be removed. Trees that cannot be pushed over should be cut as close as possible to the ground so that the stumps do not hinder compaction or obstruct vehicles. Brush and tall grass in working areas can be rolled over. A large site should be cleared in increments to avoid erosion and scarring of the land. If possible, natural windbreaks and green belts of trees or brush should be left in strategic areas to improve appearance and operation.

Roads. Permanent roads should be provided from the public road system to the site. A large site may have to have permanent roads that lead from its entrance to the vicinity of the working area. They should be designed to support the anticipated volume of truck traffic. In general, the roadway should consist of two lanes (total minimum width, 24 feet), for two-way traffic. Grades should not exceed equipment limitations.

Temporary roads are normally used to deliver wastes to the working face from the permanent road system, because the location of the working face is constantly changing. Temporary roads may be constructed by compacting the natural soil present and by controlling drainage or by topping them with a layer of a tractive material, such as gravel, crushed stone, cinders, broken concrete, mortar, or bricks. Lime, cement, or asphalt binders may make such raods more serviceable.

Scales. Recording the weights of solid waste delivered to a site can help regulate and control the sanitary landfill operation as well as the solid waste collection system that serves it.

The scale type and size used will depend on the scope of the operation. Portable scales may suffice for a small site, while an elaborate system employing load cells, electronic relays, and printed output may be needed at a large sanitary landfill.

The scale should be able to weigh the largest vehicle that will use the landfill on a routine basis; 30 tons is usually adequate. Generally, the platform should be long enough to weigh all axles simultaneously.

Buildings. A building is needed for office space and employee facilities at all but the smallest landfill; it can also serve as a scale house. Since a landfill operates in wet and cold weather, some protection from the elements should be provided. Operational records may also be kept at a large site. Sanitary facilities should be provided for both landfill and collection personnel. A building should also be provided for equipment storage and maintenance.

Utilities. All sanitary landfill sites should have electrical, water, and sanitary services. Remote sites may have to extend existing services or use acceptable substitutes. Portable chemical toilets can be used to avoid the high cost of extending sewer lines, potable water may be trucked in, and an electric generator may be used instead of having power lines run into the site.

Water should be available for drinking, fire fighting, dust control, and employee sanitation. A sewer line may be called for, especially at large sites and at those where leachate is collected and treated with domestic wastewater. Telephone or radio communications are also desirable.

Fencing. Peripheral and litter fences are commonly needed at sanitary landfills. The first type is used to control or limit access, keep out children, dogs and other large animals, screen the landfill, and delineate the property line. If vandalism and trespassing are to be discouraged, a 6 foot high fence topped with three strands of barbed wire projecting at a 45° angle is desirable. A wooden fence or a hedge may be used to screen the operation from view.

Litter fences are used to control blowing paper in the immediate vicinity of the working face. As a general rule, trench operations require less litter fencing because the solid waste tends to be confined within the walls of the trench. At a very windy trench site, a 4 foot snow fence will usually suffice. Blowing paper is more of a problem in an area operation; 6 to 10 feet litter fences are often needed. Some litter fences have been specially designed and fabricated. Since the location of the working face shifts frequently, litter fences should be movable.

Control of Surface Water

Surface water courses should be diverted from the sanitary landfill. Pipes may be used in gullies, ravines, and canyons that are being filled to transmit upland drainage through the site and open channels employed to divert runoff from surrounding areas.

The top cover material of a landfill should be graded to allow runoff of rainfall. The grade of the cover will depend on the material's ability to resist erosion and the planned use of the completed site.

Groundwater Protection

It is a basic premise that groundwater and the deposited solid waste not be allowed to interact. It is unwise to assume that a leachate will be diluted in groundwater because very little mixing occurs in an aquifer since the groundwater flow there is usually laminar.

An impermeable liner may be employed to control the movement of fluids. One of the most commonly used is a well-compacted natural clay soil, usually constructed as a membrane 1 to 3 feet thick.

Since synthetic liners have been used to construct wastewater-holding-and-treatment ponds, they may have an application in solid waste disposal operations. They are usually made of butyl rubber, polyethylene, or polyvinyl chloride and are installed in multiple layers. (If the movement of both gas and leachate is to be controlled, polyvinyl chloride should work better than polyethylene because it is less permeable by gas.) The membranes must be put down carefully to avoid punctures, and layers of soil (usually sand) must be placed on both sides of them. Asphalt liners, which have been used to reduce seepage from canals and ditches, may also have an application in a solid waste disposal operation.

The use of an impermeable barrier requires that some method be provided for removal of the contained fluid. If a natural ravine or canyon is involved, the removal point should be the downstream end of the filled area.

To help establish if a landfill is creating a groundwater and surface water pollution problem, a series of observation wells and sampling stations can be used to periodically monitor the water quality. Data on the upstream or uncontaminated water and downstream water quality are necessary to evaluate the pollution potential.

Gas Movement Control

An important part of sanitary landfill design is controlling the movement of decomposition gases, mainly carbon dioxide and methane. Traces of hydrogen sulfide and other odourous gases may also be involved.

Methane (CH_4) is a colourless, odourless gas that is highly explosive in concentrations of 5 to 15 percent when in the presence of oxygen. In a few instances, methane gas has moved from a landfill and accumulated in explosive concentrations in sewer lines and nearby buildings. Gas from landfills has also killed nearby vegetation, presumably by excluding oxygen from the root zone.

Permeable Methods. Lateral gas movement can be prevented by using a material that is--under all circumstances--more permeable than the surrounding soil; gravel vents or gravel-filled trenches have been employed. Preferably the trenches should be somewhat deeper than the fill to make sure they intercept all lateral gas flow. The filter material should be graded to avoid infiltration and clogging by adjacent soil carried in by water. If possible, the trench should be built so that it drains naturally; field tile is often placed in the bottom of the trench. The surface of gravel trenches should be kept free of soil and vegetation, because they retain moisture and hinder venting.

In another methods, vent pipes are inserted through a relatively impermeable top cover. Collecting laterals placed in shallow gravel trenches within or on top of the waste can be connected to the vertical riser. The sizes and spacings required have not been established, but they depend on the rate of gas production, total weight of solid waste, and the gas permeability of both the cover and the surrounding soil. In some cases, vertical risers have been used to burn off the gas. Pipe vents should not be located near buildings, but if this is unavoidable, they should discharge above the roof line.

Pumped exhaust wells may be used for gas venting. In this method, pipe vents are attached to the line of a suction pump to create differential driving pressure for gas movement. This method is costly and requires frequent maintenance.

Impermeable Methods. The movement of gas through soils can be controlled by using materials that are more impermeable to it than the surrounding soil. An impermeable barrier can be used to contain the gas and vent it through the top cover or simply to block the flow of gas.

The most common method, and possibly the most practical, calls for the use of compacted clay. The material must, however, be kept moist, otherwise it could shrink and crack. (Other fine grained soils may be used, with the same stipulation.) The clay can be placed as a liner in an excavation or

installed as a curtain wall to block underground gas flow. A clay layer 18 to 48 inches thick is probably adequate, but it should be continuous and not penetrated by solid waste or outcroppings of the surrounding soil or rocks. The liner should be constructed as the fill progresses, because prolonged exposure to air will dry the clay and cause it to shrink and crack.

The use of synthetic membranes was described in the section on Groundwater Protection.

Sanitary Landfilling Methods

The designer of a sanitary landfill should prescribe the method of construction and the procedures to be followed in disposing of the solid waste, because there is no "best method" for all sites. The method selected depends on the physical conditions involved and the amount and types of solid waste to be handled.

The two basic landfilling methods are trench and area; other approaches are only modifications. In general, the trench method is used when the groundwater is low and the soil is more than 6 feet deep. It is best employed on flat or gently rolling land. The area method can be followed on most topographies and is often used if large quantities of solid waste must be disposed of. At many sites, a combination of the two methods is used.

Cell Construction and Cover Material. The building block common to both methods is the cell. All the solid waste received is spread and compacted in layers within a confined area. At the end of each working day, or more frequently, it is covered completely with a thin, continuous layer of soil, which is then also compacted. The compacted waste and soil cover constitute a cell. A series of adjoining cells, all of the same height, makes up a lift. The completed fill consists of one or more lifts.

The dimensions of the cell are determined by the volume of the compacted waste, and this, in turn, depends on the density of the in-place solid waste.

An orderly operation should be achieved by maintaining a narrow working face (that portion of the uncompleted cell on which additional waste is spread and compacted). It should be wide enough to prevent a backlog of trucks waiting to dump, but not be so wide that it becomes impractical to manage properly--never over 150 feet.

No hard-and-fast rule can be laid down regarding the proper height of a cell. Some designers think it should be 8 feet or less, but heights up to 30 feet are common in large operations.

Cover material volume requirements are dependent on the surface area of waste to be covered and the thickness of soil needed to perform particular functions. As might be expected, cell configuration can greatly affect the volume of cover material needed. The surface area to be covered should, therefore, be kept minimal.

In general, the cell should be about square, and its sides should be sloped as steeply as practical operation will permit. Side slopes of 20 inches to 30 inches will not only keep the surface area, and hence the cover material volume, at a minimum but will also aid in shredding and obtaining good compaction of solid waste, particularly if it is spread in layers not greater than 2 feet thick and worked from the bottom of the slope to the top.

Trench Method. Waste is spread and compacted in an excavated trench. Cover material, which is taken from the spoil of the excavation, is spread and compacted over the waste to form the basic cell structure. In this method, cover material is readily available as a result of the excavation. Spoil material not needed for daily cover may be stockpiled and later used as a cover for an area fill operation on top of the completed trench fill.

Cohesive soils, such as glacial till or clayey silt, are desirable for use in a trench operation because the walls between the trenches can be thin and nearly vertical. The trenches can, therefore, be spaced very closely. Weather and the length of time the trench is to remain open also affect soil stability and must be considered when the slope of the trench walls is being designed. If the trenches are aligned perpendicularly to the prevailing wind, this can greatly reduce the amount of blowing litter. The bottom of the trench should be slightly sloped for drainage, and provision should be made for surface water to run off at the low end of the trench. Excavated soil can be used to form a temporary berm on the sides of the trench to divert surface water.

The trench can be as deep as soil and groundwater conditions safely allow, and it should be at least twice as wide as any compacting equipment that will work in it. The equipment at the site may excavate the trench continuously at a rate geared to landfilling requirements. At small sites, excavation may be done on a contract basis.

Area Method. In this method, the waste is spread and compacted on the natural surface of the ground, and cover material is spread and compacted over it. The area method is used on flat or gently sloping land and also in quarries, strip mines, ravines, valleys, or other land depressions.

Combination Methods. A sanitary landfill does not need to be operated by using only the area or trench method. Combinations of the two are possible, and flexibility is, therefore, one of sanitary landfilling's greatest assets. The methods used can be varied according to the constraints of a particular site.

One common variation is the progressive slope or ramp method, in which the solid waste is spread and compacted on a slope. Cover material is obtained directly in front of the working face and compacted on the waste. In this way, a small excavation is made for a portion of the next day's waste. The technique allows for more efficient use of the disposal site when a single lift is constructed than the area method does, because cover does not have to be imported, and a portion of the waste is deposited below the original surface.

The final surface of the completed landfill should be so designed that ponding of precipitation does not occur. Settlement must, therefore, be considered. Grading of the final surface should induce drainage but not be so extreme that the cover material is eroded. Side slopes of the completed surface should be 3 to 1 or flatter to minimize maintenance.

Finally, the designer should consider completing the sanitary landfill in phases so that portions of it can be used as parks and playgrounds, while other parts are still accepting solid wastes.

QUESTION PERIOD - SMALL SANITARY LANDFILLS : DESIGN

Question: **(unidentified)** Are there any sanitary landfill operations with all the specifications you've given here in operation in the province?

Answer: **(Mr. MacKenzie)** In the province, not that I'm aware of.

Question: **(unidentified)** Can you tell me an approximate cost of opening a sanitary landfill? Just a guess of all those things, the pipes to vent the gases. How can it possibly be geared to a very small municipality, aside from the fact that most small municipalities can't afford to have a bulldozer on the site full time?

Answer: **(Mr. MacKenzie)** That's why I spent an hour telling you that you could co-exist with a dump so long as a certain amount of planning goes into its operation, because that's it. I mean it's recognized that the sort of funds that are put aside for solid waste management have, since Roman times, been virtually non existant, so you know we've had to make do with very Mickey Mouse systems. So the idea is that if you can afford it, then sanitary landfill is a next logical step.

Question: **(unidentified)** How serious a problem is methane gas?

Answer: **(Mr. MacKenzie)** I think the answer would probably come in the next section.

Question: **(unidentified)** Is it a serious enough problem that eventually - I'm talking about the whole province - if we have lots of closed out dumps, how serious is the methane problem going to be then? I mean, you know, is it too late for us to start doing something or is it serious enough that everybody should do something for a municipality?

Answer: **(Mr. MacKenzie)** If the dump just happens to be in the right kind of soil, the gas has probably been venting off it for years. And of course, the longer the stuff sits there, the less decomposition you're going to get, presuming that you're not continually adding something to it, so if its been there for a while, then I would think that chances are that the gas problem isn't all that bad. On the other hand, the nature of the soil may have caused it to be accumulating all these years.

Comment: **(unidentified)** In how many spots all through the province has it been accumulating over these years, and in how many spots will it? I'm not asking as a question its just a remark.

Comment: **(Mr. MacKenzie)** Right. I can't speak to what the situation is in New Brunswick. I guess Ray can.

Comment: **(Mr. Benoit)** Methane accumulates whenever there is soil cover ... over an open dump ...

Question: **(unidentified)** Then as you operate a sanitary landfill you are creating a problem?

Answer: **(Mr. MacKenzie)** What we're also saying is that in the design of the sanitary landfill, you should recognize that you are going to get decomposition and that when you begin an operation or begin the construction of it you should allow for some way of venting it off, gradually as it's produced. Don't let it build up, because if it does build up, if oxygen does get in there in the right quantities - boom. Or it could move away from the site, as has happened.

Question: **(unidentified)** Would you think it vital that each small municipality be idealistic enough to do this sort of thing? Would it be more costly to do that or would it be more costly to have a sort of a collection system as you were talking about in Prince Edward Island - not one, but several central regional dumps.

Answer: **(Mr. MacKenzie)** That could very well be the answer and this rural collection system idea is catching on. There have been two or three established, successful operations in the U.S. There's one in northern Ontario, in the Muskoka Lakes area, and P.E.I. is obviously considering it and as I said earlier we are going to talk more about that later. I think for a lot of rural areas, a lot of areas where there are small towns and villages, it is considered to be a very, very neat alternative.

Question: **(unidentified)** Would it be viable to take the gas that's being wasted and use it? I noticed the standpipes, there's one picture there and I've seen the standpipes but I didn't know what they were. We don't have this problem in Fredericton because nothing is compacted enough to even cause gas.

Answer: **(Mr. MacKenzie)** Right. Well, I've heard of guys who've made little devices to run their cars on it, but I have my doubts that it's practical. Who knows, there may be one particular occasion where you can do something with it. Ted's got an answer.

Answer: **(Mr. Rattray)** The situation that I'm aware of is that there's not very many places that have sufficient volumes. Certainly in this province, I don't think you'd have locations which would have sufficient volume to warrant putting in the capital equipment and the like to use the gas coming off. There are a couple of experiments going on in the United States - notably the one near Los Angeles where there are landfill sites that are several hundreds of feet deep in deep canyons, and they are artificially irrigating these particular landfill sites to accelerate the gas production. They are in fact collecting the gas and they're running it through a commercial gas system that feeds homes adjacent to this particular landfill site. It is a viable operation. This is done by a private gas company in the area and is certainly being looked at as an alternative in some of these particular sites. Mind you you're talking hundreds of feet thick and it's a different situation, where you have a much flatter terrain to work with and you have that much more equipment involved in setting up your system and, of course, your gas is not necessarily marketable in that particular area. It doesn't look to be particularly attractive to most Canadian situations, certainly in the less populated provinces. I don't think it would be very attractive at this point.

Comment: **(Mr. MacKenzie)** I'd just like to add one little element of perspective on that. The composition of this decomposition gas, being high in methane, is very nearly the same as natural gas. It's called synthetic natural gas when it is not made in a landfill but it is basically the same stuff.

Question: **(unidentified)** Is it not reasonable to assume, and we must assume, in the future not the past, that before too long that the garbage collection from, say, Saint John, Oromocto and Fredericton, we'll just use those for an example, be picked up and taken to the coal cuts in Minto?

Answer: **(Mr. Rattray)** I'm not sure how practical it is. I'm not sure of how many miles are involved in transporting the waste. It sounds to me like a fair distance.

Question: **(unidentified)** You've already said that it's not a good thing to build - put buildings on - reclaimed sanitary landfills but are there many instances where buildings have actually been built on them or in them?

Answer: **(Mr. MacKenzie)** I don't know if there are many but there certainly are instances where there have been and, I think, a lot of it depends upon, again, the planning - the pre-planning. If you have controlled the rate of settlement and, I'll get into this a little later, if you know that once the landfill is completed that you are going to build buildings on it, then obviously you can include a lot of demolition rubble and waste in the site or you can sort of create little islands within the site where the foundation for that particular building will be. Otherwise, you are going to have problems with settlement and you could have gas problems and it's not very nice when the gas just happens to migrate into the basement of these buildings.

Comment: **(unidentified)** That's what I was getting at. I don't know where I've heard it but I did hear that probably the only way to do it is build on slabs and not have basements. Then you can build.

Comment: **(Mr. MacKenzie)** Ok. I'm not going to say that you can't have basements but I will mention later that generally you would sink pilings down through the stuff.

Question: **(unidentified)** I was thinking of the point that was brought up there on how prevalent is the gas generation and apparently the methane gas generation is pretty prevalent.

Answer: **(Mr. MacKenzie)** I think it's a safe assumption that it's going to happen. So, the object of the game now is to do something with it. To just gradually control or vent it.

Question: **(unidentified)** But it can be more of a nuisance than an asset?

Answer: **(Mr. MacKenzie)** I don't know if it would be an asset at all except for Los Angeles.

SMALL SANITARY LANDFILLS : DESIGN LEACHATE FROM LAND DISPOSAL

Mr. T.E. Rattray
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Solid Waste Management Branch
Environmental Protection Service
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Ladies and gentlemen. This morning Bob talked about sanitary landfilling from the point of view of hydrology, climatology, geology; general design of the unit and he's going to talk a little later about actual operation.

What I'd like to discuss is why? Why do we have sanitary landfilling? Why are we recommending sanitary landfilling? What is the concern with the dumps that we have? What is this thing called leachate? How is it formed? Is it really a concern? Is it toxic? To whom? To What? Is it really retarded, or as we call it, attenuated in soils? How is it attenuated? To what extent? Can it be treated? How much will it cost? I'm going to try to put the whole question of leachate in perspective if I can. I'd also like to briefly touch on the question of industrial wastes in sanitary landfills.

What are the concerns? What do we know about it? I'd like to in summary, tell you what we in the federal government are doing what other provinces are doing, what other research people are doing, what people are doing in the United States, what people are doing off the North American continent, and suggest to you where we think we ought to be going from here and the reasons why.

HOW IS LEACHATE FORMED?

The first question that we must ask is, of course, how is leachate formed? Leachate is formed from water percolating through solid waste in a landfill and carrying with it soluble, generally speaking, soluble organic and inorganic substances. I'll return to the composition of leachate in a moment. In areas of high rainfall, certainly the Maritimes and a lot of Eastern Canada have such conditions, percolation of water through the soil is in fact a very natural occurrence. It is, of course, the principal mechanism for ground water recharge. So precipitation falls to the ground and either infiltrates or runs off the surface. In an open dump, run-off is, generally speaking, quite minimal, which means that you have a fair amount of what actually falls infiltrating into the site, less that of course which goes off in evapo-transpiration. I think that the diagram of the schematic in Figure 1 is reasonably self-explanatory.

I think it's fair to say that any excess water, after you've reached the capacity of the site, is going to work its way into the solid waste. The solid waste is going to act as a sponge. It will simply absorb the water until it reaches its capacity. Eventually, of course, once that capacity is reached any more water entering into the landfill site causes an equal quantity of water to leave in the form of leachate. Some leachate will in fact be formed even prior to reaching landfill capacity simply because of the channelling effects, because in some particular cases there are wastes other than municipal ones going in there. There are a lot of liquid wastes going in, whether they be septic pumpings or whether they be industrial wastes, and certainly the non-homogeneity of solid waste does result in leachate as soon as, in some cases, two months after it has been disposed of.

Leachate Characteristics

Well, what is this leachate?, and what are its characteristics? Naturally, of course, the characteristics of the leachate are a function of the type of waste that goes into the land disposal site, and its a function of the age of the site. Bob mentioned this morning that you have leachate peaking in the early years and then tapering off as a function of time, assuming you have no more waste coming in. It is also a function of temperature. It's a function of the moisture you have in the area and a number of other parameters.

I know that in talking to a lot of different people in North America involved with this particular problem, we have a tremendous range of values for leachate, and when you get down to the point of talking to the people responsible for actually doing the analysis you find that there is a tremendous variation in the way people actually analyze their leachate. I'm not so certain that a great deal of the variation in leachate isn't due to the analysis as opposed to the types of material that are, in fact, causing the leachate.

In any event, I'd like to mention that a few weeks ago we had a seminar out in British Columbia where we invited people from across the country, who are in the analytical field, the chemists who are responsible for analyzing these leachates, from across Canada and across the United States. We had an excellent day. The results of those particular proceedings will be available soon and I think that you'll find them quite interesting. I know there was tremendous controversy at the meeting and as a result of that meeting we've had a lot of direction as to what to do and what not to do in both the sampling and the analysis. This information is on typical municipal solid waste if there is anything that is typical. It varies, obviously, from one end of the country to the other, and I'd like you to just have this in the back of your mind as I start to go through the actual characteristics of the leachate itself.

We'd like to look at the physical, biological, and chemical characteristics, and what I'd like to do is compare these to something, that perhaps some of you are familar with, so I've used raw sewage as a guideline. Everything is expressed in parts per million and I'd like to stress before I get into some of the characteristics and some of the implications of leachate that this is in fact leachate at the bottom of the fill. It's leachate before it gets any dilution or before it starts moving through soils from the site.

Physical Characteristics

Generally speaking, the physical characteristics do indicate a nuisance and they are in fact a pretty good warning signal. Of course you're all familiar with the color of leachate and it serves as a warning. Most objectional, however, is probably the odour. Leachate has a very strong odour and there have been some that suggest that it's probably the phenolic content in the leachate. Certainly any water supply being contaminated by leachate would probably be abandoned, if not for the phenolic content then for any number of other reasons. But it certainly does impart a taste and an odour.

There's really little data that I've seen, at any event, on the density of leachates. Being dissolved in different materials, some of it is heavier. By virtue of it having, in some cases, a lot of organics it in fact can be lighter than natural water. It's interesting that in some of the land disposal studies, some of the monitoring studies that have been done on landfill sites, and I think Bob touched on it this morning, the fact that the leachates came off in a sort of laminar flow and this very well may be the fact. You have distinct density differences between leachate and water that infiltrates from rainfall, also between leachate and groundwater. In one particular site we are looking at right now there is an actual lens, if you will, it's not dictated by the soil. This is a uniform sandy soil but there's a lens of leachate that comes off the landfill site and travels horizontally and above it you have good water, below it you have good water, and you have maybe 15 or 20 feet of leachate that's going along with very, very little mixing. This is a concern, because it was thought that there's a tremendous amount of dilution capability coming out of

landfill sites. But in fact now we find that in some sites there are these streams of concentrated material moving along.

Biological Characteristics

From Table 1 you can see that I have both leachate and raw sewage as an example of biological characteristics.

TABLE 1 BIOLOGICAL CHARACTERISTICS (mg/l)

	Leachate	Raw Sewage
BOD 5 - 20 (mg/l)	10 - 54,000	100 - 200

You can see that not all leachate has 54,000 or anything close to it, parts per million. Generally speaking you are talking about several thousand parts per million in terms of leachate BOD. This, of course, varies whether you are talking of 5 day and ultimately a 20 day BOD but generally speaking you are in that kind of a range. Looking at raw sewage it's pretty potent or can be pretty potent material from the biological point of view. Certainly BOD is a serious problem if the leachates coming out of the site are going to receiving streams or creeks or somewhere where it's evident right away. If you have BOD in groundwater perhaps it's not as serious a situation but certainly if it is going to drinking water from groundwaters that have been polluted by landfill leachate, there is, in my opinion, sufficient cause for concern that one would start looking at some other disease causing micro-organisms as we do in sewage treatment.

Chemical Characteristics

I am going to break down chemical characteristics into a couple of different groups (see Table 2).

TABLE 2 CHEMICAL CHARACTERISTICS (mg/1)

	Leachate	Raw Sewage	PHS
Nitrate	.2 - 1300	3 - 10	10
Sulphate	28 - 3770	-	250
Chloride	4.7 - 2467	50	250
Iron	0 - 2820	.1	.3
Hardness (Ca CO_3)	0 - 22,800	100 - 200	-

Firstly, lets look at the traditional parameters that are used for characterizing raw sewage, and you can see again leachate is pretty powerful material, in terms of actual concentrations. You are aware that nitrate is converted biologically, and can be converted into nitrite. Nitrite, of course, combines with blood hemoglobin, and it is a fact that it can cause blue babies. Nitrites can travel through water, they can travel through cow's milk, they can travel through any number of different ways and for this reason it is in fact a health concern and the people who are responsible for drinking water standards have recognized this for a very long time. So, nitrite does exist in leachate. Sulphates and chlorides have taste effects. Chloride is a problem in some industrial operations if they happen to be using the groundwater in question. Sulphates can cause corrosion. Of course we're familiar with the laxative effect that sulphates have. Of

course we know what happens when we have a lot of iron in our water, our wives scream about their laundry. Iron can in some cases be a problem in receiving streams if there's enough of it. In hardness, generally speaking, it's just a nuisance in terms of industrial users and scaling of different pieces of equipment.

TABLE 3 OTHER CHEMICAL CHARACTERISTICS (mg/l)

	Leachate	Raw Sewage	PHS
Copper	0 - 9.9	.5	1.0
Manganese	.1 - 125	75 - 125	.05
Zinc	0 - 370	10 - 30	5

With respect to other chemical characteristics, let's have a look at copper, manganese, and zinc (see Table 3). Copper can be tasted in reasonably low concentrations. We know that over prolonged periods of time it can cause liver damage. We know that copper is toxic in low concentrations to fish. Manganese, again, is like iron. It imparts a brownish color to laundry operations. You can also taste it in reasonably low concentrations. Zinc imparts to water, if there is very much of it, a bitter taste and there have been people who can pick it up as low as 30 parts per million.

Perhaps the most, or at least potentially serious concern about leachate is contained in at least a couple of these materials, lead and cadmium (see Table 4).

TABLE 4 HEAVY METALS (mg/l)

	Leachate	Raw Sewage	PHS
Lead	0 - 5.0	0.1 - 2.0	.05
Cadmium	0.4	0.3 - 17	.01

We don't know a great deal about lead even though we are studying it very hard in terms of air pollution and water pollution and everywhere you can think of lead comes up. It seems to have a potential for accumulating in the body, which is potentially harmful over prolonged periods of time.

There have been a number of different studies done on cadmium and I suspect that most of you are aware of these particular concerns.

I want to mention two things in connection with most of these chemical characteristics. We are talking about the leachate rate at the bottom of the fill. Now, there is in fact pollution aside from the fact that you have these laminar flows coming off. There is in fact a fair amount of pollution in the ground and for that reason perhaps we've been fortunate in not having very many cases, at least very many known cases, of poisoning or problems relating to land disposal. There is some other information becoming available now. Research is being done on the west coast of Canada, examining the leachate fish toxicity question, and we are hopeful of funding this year a major study in this area, not necessarily or simply because of the Fisheries Act, but we think that fish or at least our work in the past has indicated that fish have detection limits that are perhaps a little bit more sophisticated than human beings, at times.

Attenuation

If you are fortunate enough to have an unsaturated zone between your landfill site and your saturated zone all the better (see Figure 2). But attenuation is affected basically by three processes in soils. You have the physical, chemical, and the biological degradation, and you have them in two distinct zones. You have them in the unsaturated zone, you have them in the saturated zone. Of course, the physical process is simply one of filtration depending upon the size of the suspended matter or the colloids in your waste and your leachates and also depending upon the pore size of the soils you either do or do not get physical filtration.

Chemical processes are extremely complex. People have attempted to identify cation exchage capacity, oxidation-reduction potentials, and chemical precipitation, even in the most simple systems where we have uniform leachates of known composition. I'm not talking municipal leachate. That's a real mix. I'm talking about some industrial wastes that are very uniform, and in the simplest of soils we haven't really been able to get a handle on, from the theoretical point of view in any event, what actually takes place. I am not sure if we ever will. It is such a complex situation and so many different things are occuring simultaneously.

The researchers have chosen to look upon it as sort of a black box situation. That is to say you have this kind of material going in as waste, you have this kind of soil, and this is what has happened under the following climatic and hydrogeological conditions. That is test case A. Then they fill in another test case and you have more information and then on it goes and you fill up a great big grid, three, four what ever dimensions, and you say these are the likely consequences of this kind of material going to this kind of soil under these conditions. That I think is about as well as we're going to do for some time. The mechanisms are just too complicated.

From the biological point of view if you are in the unsaturated zone, you are going to have biological degradation taking place as long as there's oxygen present, or in the saturated zone you're going to have decomposition taking place as long as you have oxygen. Unfortunately you don't always have the oxygen and when you get into the anaerobic decomposition you get different materials, sometimes not nearly as pleasant as with the aerobic decomposition, and you have some concern for the organic materials coming out of leachate. In addition, when you get into the anaerobic condition, in many cases you bring the whole environment into a reduction state as opposed to an oxidation state. You generally lower the pH and what happens under these conditions is you start to mobilize some of your metals, which are of course generally speaking, with the exception perhaps of molybdenum and a couple of others, more soluble at the lower pH's or in their reduction states than they are in the oxidation states. So, you start getting some of them moving and this of course is not too pleasant.

I wasn't aware up until about 6 or so months ago, that the situation in the Maritimes is extremely different from the situation in Ontario where a lot of the work has been done in relation to land disposal of materials. The situation in Ontario is basically that most of their soils are of a glacial deposit and the structure of the soils is such that they have a fair buffering capacity on the alkaline side of neutrality. I understand from talking to some of our people in the regional office down here that in fact your situation is not unlike parts of British Columbia. Namely your soils are generally a little bit on the acid side, basically your soil chemistry is controlled by perhaps aluminum radicals as opposed to carbonate radicals. This is a concern to me, simply because all the work that has gone on elsewhere in Ontario with this buffering capacity has perhaps given us a bit of a false sense of security. In the buffered condition most of our heavy metals are very quickly attenuated in the soils. But I think if we have to start getting into lower pH soils, which you may have a fair amount of down here. It is certainly going to be in our interest to get involved in it because it certainly does occur on both sides of the country.

Naturally of course the rate and the distance of leachate flow will have a tremendous effect on the efficiency of a given soil for attenuating these leachate substances. Material such as sand, gravels,

cracked limestone, fractured shale, this type of thing. They offer very little resistance to attenuation or very little capability for attenuating these wastes. Clays on the other hand offer good attenuation for a number of different reasons; because of their organic content, because of their fine grain size. On the other hand, if you have too much clay, what happens is your leachate comes down and hits the clay and goes scooting off to the side. Unless you have a good geologic condition, you can in fact get into situations as is quite common in a number of Ontario landfill sites where the material goes down what we thought to be a reasonable good situation and hits the clay, scoots off to the side and slips into our receiving stream. Mind you some of it goes through, but you know in some cases as much as 50, 60, 70% of the material, in fact goes off the side. Of course the fate of the leachate that might go off horizonally is very site specific. If it goes into a receiving water, depending on the size of the receiving water it may simply get mixed in with the total flow and not become a problem. If it is a very small creek, it can in fact become a problem. Furthermore, not all landfill sites have this unsaturated zone. There are a lot of places where you just don't have within, any reasonable hauling distance a site that is not in fact very close to the water table, and of course under these conditions, that don't have the unsaturated zone, you expect to have less attenuation.

I mentioned the question of dilution before. I think this is where it is become apparent to us in any event that you really must have good hydrogeologic information. There is so much that can happen in a given site that is insitu or site specific, that you really must have proper qualified people to assist you in this particular area. Attenuation, as groundwater is withdrawn by some user, will depend to some extent on the amount of water that is actually drawn out. If you have a very large user of water in the area and that particular user is drawing a tremendous amount of water from the large water shed area, then you can expect a fair amount of dilution. If on the other hand it happens to be a very small user and he happens to be in line with the leachate flumes then you might in fact have a problem.

How Much is Formed?

The question is often asked how much leachate is actually formed, how much leachate exists underneath some of these landfills? I have to do some theoretical calculations here, and I made a couple of assumptions, but if you assume that the surface water flows have been diverted around a land disposal site, that is to say the site is separated, if you will, then infiltration is the result of direct precipitation. Potential leachate quantities will vary considerably depending on the amount of net infiltration at any given location. If we look at eastern Canada and let us suppose we talk net infiltration of something between 10 and 20 inches a year, then you could get considerable quantities in terms of actual volume of leachate. As a matter a fact even in some cases where you don't have a large net infiltration in a year's time, you may get all of your rain in one particular season, one particular time of year, and you still get a fairly major net infiltration.

Relating the size of the landfill site to the volume of leachate generated with an assumed 12 inches of net infiltration, I don't think 12 inches is unrealistic. I know in many cases in the Martimes you get a good deal more than 12 inches. I just want to give this kind of relationship and I think maybe I can just give it to you as a single figure. An acre of landfill with a net infiltration of 12 inches a year, is going to produce something in the order of two hundred and seventy thousand imperial gallons. That is a fair amount of water. On the other hand, it must be appreciated that most of our landfill sites are in fact surrounded by tremendous quantities of land and it is not very long before that figure becomes pretty small in terms of the total amount of dilution that might be capable, assuming that you don't have a user very close to your landfill site.

Other Concerns

So far I have built a theoretical case presenting leachate as a complex, nasty substance, which will be produced after you dispose of your waste in land and after your landfill site reaches field

capacity. Under certain soils and hydrogeologic conditions the leachate will travel and may pollute the groundwater, may pollute surface waters and yet we have not really heard of too many actual cases where leachate has been a problem and, of course, you have to ask the question "why"? The number of cases of groundwater contamination that we know about seems to be small. We are aware there is a fair number that we don't ever get to know about. Sometimes a well is not being used in the immediate proximity. Then, of course, you don't have any way of knowing whether or not you have a problem. It is not like seeing the pipe depositing its waste into the receiving stream. It goes down. It is almost an insiduous kind of a situation. I believe it is a concern for many different reasons. You are aware, of course, of the difficulty of acquiring land close to urban centers, and in parts of this country the land that is most suited to land disposal of waste is in fact that land which is best suited for agricultural purposes. But, I think there are other concerns as well. Certainly it is known that toxic substances, industrial wastes are increasing both in quantity and in complexity. Furthermore, I don't think there is anything more certain that sooner or later, if improper land disposal is permitted to continue within areas where some of these wastes are land disposed of, incidents of river and groundwater pollution will occur, and I think they are going to occur with increasing frequency. I also believe it is a concern in that if control is left until such time as you find it either through a well or for any other reason that you might be sampling the groundwater, it might be literally decades before you can rid yourself of that problem. Once it is there it is very very difficult, even if you were to move all of the material in the landfill site. It is very, very difficult to reduce that problem over anything short of decades of time. I think as well in some particular cases, and I know Prince Edward Island is one, there is a tremendous dependance on groundwater for actual potable water supplies. In other provinces we have a fair amount of surface waters that are, at this particular time, not yet polluted to the point where you can not do anything with them. Maybe the concern's not there, but maybe as time goes on, while preventing river pollution is most important, preventing groundwater pollution may be even more important.

COST OF LEACHATE CONTROL

If you can locate a site which can rely on local soils and hydrogeological conditions for leachate control, then there is no "extra" cost. Unfortunately, that is not always the case. You can not always rely on an impermeable cover to prevent net infiltration, it just does not work out in reality. You can reduce it certainly, but you can very seldom ever completely prevent it. So, if you are into a situation where you don't have good natural purification, and there are a lot of cases where you do have good natural purification, people of course want to treat their leachate anyway. This does not seem to be a very realistic approach, but that is in fact the case simply because of pressure groups, of one form or another who insist on leachate treatment systems whether of not the hydrogeologic system dictates it. So, if you must install liners, collection systems, and then you must go about treating your waste, you can look at, generally speaking, a dollar, maybe dollar-fifty or more per ton of the waste coming in, just to treat the leachate that is going to come off the bottom of that waste. That can get pretty expensive if you start looking at a community of 100 thousand, 50 thousand tons going into their landfill site in a year and you are looking at a dollar-something a ton. You are starting to get into a lot of dollars. There are some communities of course who tap off their leachate and take it into their sewage treatment systems, but generally speaking the landfill sites are not located anywhere close to a sewage treatment system, even if that community does have a sewage treatment system. So, it makes it an expensive proposition. I think you are much better off finding a more suitable landfill site, than you are having to treat your waste, but this of course is only something a consultant in a local situation would be able to tell you after careful study. If you have to move a site, because of problems, physically you go in there and bulldoze out, scoop out all the waste that is in there. This is being done in some particular cases in the U.S. right now, simply because they have contaminated water supplies. They have by virtue of court decisions and the like, been ordered to go in and remove these materials. They are looking at 12, 15 dollars a ton simply to remove these things and in those cases they had landfill sites that were not too far away to truck it to. So, it can

be extremely expensive if you don't take the proper controls in the first place. You have to go back in and try to pick up the pieces afterward.

INDUSTRIAL WASTES

The nature and the concentration of industrial wastes add considerable concern to the toxicity or the possible toxicity of the leachates. Also the very fact that a lot of industrial wastes are liquid or semi-liquid in nature adds to their potential mobility in landfill sites.

There is a concern over the non-compatibility of different wastes that might go into a landfill operation, with or without municipal wastes, and there is a very good document that I have just become aware of that has just been publicly released, from the State of California. It lists various non-compatible chemical substances that they have received over a very extensive survey period in California, coming from industrial sources, generally speaking, although some of them are municipal. These non-compatible wastes are listed in table form. You are able to see that this group is non-compatible with that group because the following might happen. Then you have another group, this is non-compatible with that one because the following might happen. As a result they have in California in the operation of their sanitary landfill sites a grid system and they put their wastes in various cells. Now they have the fortunate position in a lot of their sites of having net water deficient areas which we don't have, certainly not in eastern Canada. As a matter of fact we don't have it in much of Canada other than perhaps a few places in the Prairies. So, they put these wastes into this grid system and of course the grids are lined by earth and materials.

They have concerns as do I over liner integrity, they have concerns over the artificial liner integrity because of the possibility of puncturing them. I personally have seen quite a number of liners used for industrial wastes. I have seen what happens to them over a period of time and I have seen some that have been in for ten years now and they are not in very good shape at all. You can walk on them and put your foot through them. Perhaps they were not properly chosen in the first place, perhaps the wastes that went into some of the liners should never have gone in because they had some potential reaction. In any event, there is concern over artificial liners and in California over natural liners. They have had a number of situations where they have suggested that the nature of the chemical wastes that were going into clay lined dikes or systems were such that it reacted. The clay reacted with the industrial wastes and they had a deterioration. They ended up having to go around again and rebuild some of these dikes. I can think of a couple of situations, where they talked about a nitric acid waste and they talked about a high calcium, I think it was a caustic waste, in both cases they had some trouble with clay. We hope to be able, this year, to do a study on the west coast, simply because of availability of equipment out there, to look at the compatibility of some industrial wastes with a number of different clays. That work hopefully will be available within the year.

Obviously there is some concern over the potential for the concentrated industrial waste to exceed the attenuation capacity of the soils that might be below it. If you have a mixed waste and you have many different types of chemical characteristics in that leachate, it is not quite the same thing as having all of a particular type of industrial waste in one particular location in a landfill site, where all of that particular contaminant goes through the soil, simply because the soils are selective in what they remove and what they can remove in certain situations. If you overload them with one particular chemical substance you can just exceed the exchange capacity of that particular soil and get into problems.

There is some concern over the possibility of combining municipal and industrial wastes, simply because of the synergistic effects that take place. I mean you have compounds that are created that would not otherwise be created because you brought the two together. On the other hand, if you were to ask, "Well am I better off not to put my industrial wastes in with my municipal wastes or in my landfill site?" I think the question has to be asked "Is it in fact not the better or lesser of two evils?" If you know your site, if you have good knowledge of your landfill operation, your hydrogeologic information

that is necessary, then, perhaps you are better off putting your industrial waste there, than simply letting it go in whatever other indiscriminant fashion that might occur.

WORK IN THIS AREA

I would like to close in suggesting what we at least in the Federal Government are doing, and what other people are doing in this area and where we believe we are going. Firstly we have quite a number of studies underway right now on 26 different industrial waste groups. These particular studies are being done by various consultants throughout Ontario, some are represented here today, and these particular studies are, generally speaking, identifying some schematic process information and the types and characteristics of the wastes coming from these operations that are going to landfill. Now in some cases these industries may exist down here and in some cases they may not. In any event, I think in many cases we just don't have a handle on what in fact the characteristics are of the solid wastes, or whatever semi-liquid wastes that are going to landfill from these operations.

We have a lot of work underway on leachate-soil interactions. We have some theoretical work going on in university. We have some laboratory studies where we are actually taking liquid, semi-liquid, industrial wastes and we are interchanging them with various soils under various conditions to see what in fact moves and what does not move under various conditions. We have five actual landfill sites under study, some of them have received considerable quantities of liquid industrial waste, others principally municipal waste. We have detailed monitoring programs, analytical programs set up in these particular sites, and we are investigating in the field the same questions of attenuation and what chemical species are moving from these sites in various soil conditions and various climatic conditions and what ones are staying behind. We hope to be able to pull these three different areas together and before perhaps the end of 75/76 have what you might consider a what to do and what not to do. Or the do's and the don'ts, if you will, of some industrial wastes in some particular soil conditions. I think this is something that will be useful. It won't be in the form of regulations. The Federal Government has regulations for its own federal facilities but of course the provincial jurisdiction in solid waste is such that they would write the regulations. But I think it will be useful information to every province faced with industrial waste disposal.

I mentioned work at the University of British Columbia on the west coast. They are working on municipal wastes and lysimeters. They are also working on wood wastes and I think that may be of interest to some of you people. There are leachates coming off wood wastes. They have found interestingly enough that the leachates varied between different species, which means that you have to do an awful lot of work to find out what your particular problems are. But none the less they are characterizing, they are looking at the treatability of the leachates coming off wood wastes and municipal wastes. I mentioned the toxicity work, the fish toxicity work from landfill leachates. I think that is going to be valuable work.

I might just mention the work that is taking place in the U.S. and the United Kingdom. We worked with the U.S. by virtue of a lot of our work taking place under the auspices of the Canada - U.S. Great Lakes Agreement, and we worked very closely with the research people of Cincinnati, and the Washington Office of Solid Waste Management, of the EPA. I think at this particular point our programs fit together reasonably well. They are looking at other wastes than we are, they are looking at other soils than we are, but they are looking at the same kind of interaction information that we are and we are exchanging a lot of information with them on this. The United Kingdom program I just learned about several months ago. They have a very extensive 6 million dollar land disposal research program underway, and it is rather interesting. The United Kingdom of course is very much dependant on groundwater for drinking water supplies and they did a study of several thousand of their landfill sites not very long ago. Based on that study they have plugged in a 6 million dollar land disposal study. Principally it is directed towards industrial and hazardous wastes. But I think it is significant that they have

seen fit to put that much money into land disposal studies. I think maybe they know something that we don't. Maybe they have been doing it longer and maybe their problems are occuring now, where ours are ten years down the road.

So, generally speaking then what we are looking for, is if we can characterize the situation for specific combinations of soils, different wastes under different hydrogeologic conditions. We hope to be able to pull together what might be a loading rate, if you will, so many pounds of what particular type of substance from whatever source, from whatever industrial waste, whatever the municipal waste per year per so many acres of landfill site. So basically that is the direction we are going as far as land disposal is concerned.

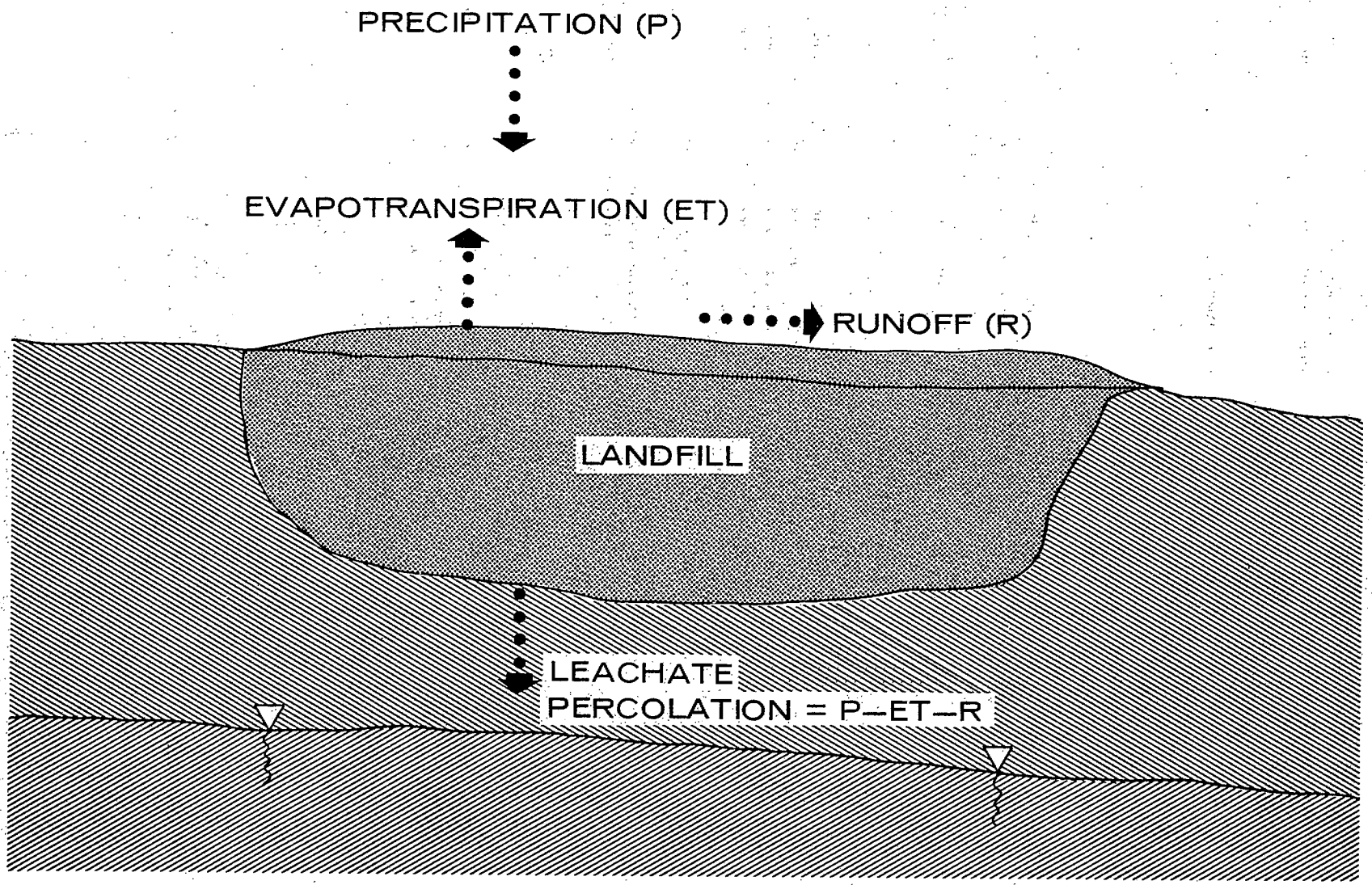


FIGURE 1 DIAGRAM OF LEACHATE GENERATION

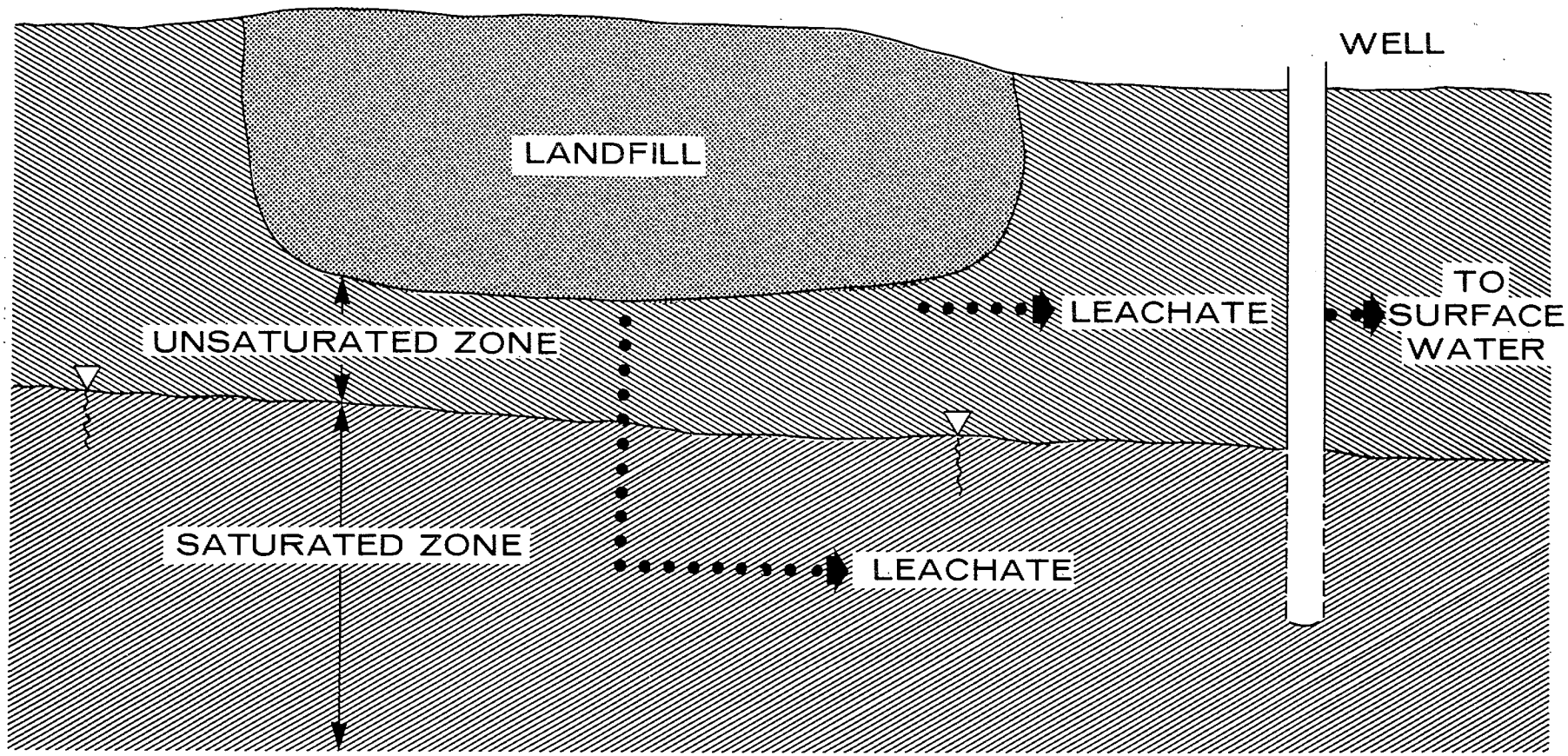


FIGURE 2 LEACHATE FLOW THROUGH PATH THROUGH ZONES WHERE ATTENUATION MAY BE EFFECTED

QUESTION PERIOD : SMALL SANITARY LANDFILLS - DESIGN

Question: **(unidentified)** I have a question concerning treatment of leachate. I know you said that landfills should be located where natural treatment is achieved, but where the leachate is treated by other means what is the most common method of doing it and is it batch or continuous?

Answer: **(Mr. Rattray)** It is a difficult question to answer. The work that has taken place to date has been of different types. There has been traditional biological treatment. I say traditional in the sense of what we know to be a sewage treatment kind of operation. There have been physical-chemical systems. There have been systems where they recirculate the leachate back through the landfill site. But I think most of us are aware that by recirculating it back through the landfill site you are able to reduce considerably your organic load, but you still have a number of persistent inorganic chemicals that in fact do build up over a period of time, after you have saturated the site with them. And in many cases in Canada where you don't have a net water deficit the recirculation of leachate onto a landfill site means that if you are collecting all the leachate off the bottom, what you are in fact doing is gradually increasing the amount of volume that you have to recirculate so that does not solve your problem. You still end up having to blow down. I mentioned the system, I believe, where they take the leachate in a tanker truck, like they do a sewage sludge truck or a septic tank truck and they truck it off to the sewage treatment system and put it in. I'm not aware of any unique systems that are located in small communities, that, because of not having natural systems to treat it, they take the leachate off, treat it on site, and then simply discharge the water to a receiving stream. Perhaps there are some other people here who are. I don't know.

Question: **(unidentified)** Has evaporation been used in small communities?

Answer: **(Mr. Rattray)** Evaporation works well, of course, in California. It works well in some particular locations at some times of the year, and yes that is in fact a situation that is not uncommon. But in our situation that we have here, I think we have a fair problem, simply because whatever lagooning arrangement we had would be continuously overflowing because we don't have the kind of climatic situation that enables us to do that kind of thing. It's a problem because it is getting worse as opposed to getting better.

Question: **(unidentified)** What happens to the oil, if people bring oil into the dump? What are you supposed to do with that?

Answer: **(Mr. Rattray)** Waste oil is handled in a number of different ways in different locations. There are people who are recovering it now, and I suspect there are some locations in the Maritimes where it would be worthwhile going after the waste oil. The problem with most waste oil I think, is that the waste oil is either really contaminated with other materials in it, or it is diluted within a water material. In those cases where they have not been able to recover the oil, some people are taking the oil and discing it into soil. They are spreading it over the land. They are discing it into about six inches of soil and biologically treating it in the ground. This is taking place in Canada. It is taking place in areas where we don't have a negative moisture deficit. These people who are doing it, basically the petroleum companies, have been promoting this type of approach. They have found they had to take some precautions. Firstly, the oil is of course an organic substrate, and can be used by

micro-organisms in the soil and broken down into relatively harmless materials. You do have, however, the necessity of keeping the nutrient balance. You must add nutrients as you would to any other biological system in order to have these things grow well and consume the oil. You can't allow the oil to build up in layers and control the situation underneath because there are several constituents of oil, the naphthenes and some of the other cyclical compounds in oil that are both water insoluble and not very pleasant at all if they are released by virtue of going through anaerobic conditions. Furthermore you get quite a problem if you allow the situation to go anaerobic. So there are some problems with land disposal of oil, but it is in fact taking place. You may have to be specific on the kind of oil you have and what you have in the oil. There are other places that are of course burning it. You can ship it from here to Montreal, and in some places in Ontario which will take oil, assuming that it has a net positive value and they simply burn it in a properly controlled incineration operation. In other cases you have chlorinated hydro-carbons in with the oils and this really does pose a problem, simply because the chlorine comes off these materials in the stack, and unless you have a scrubbing system on the incinerator, the incinerator is not permitted to use it other than in dilute concentrations. So you either bleed it in at very low concentrations if it's got chlorine in it or you go to one of two incinerators in the country, one in British Columbia and one in Alberta or Saskatchewan that can scrub the incinerator gases coming off.

Question: **(unidentified)** What is recommended for handling demolition materials and tree stumps?

Answer: **(Mr. Rattray)** I don't know if I have a definite recommendation on how to handle these, other than our experience to date. In many landfill operations where we know there has been a fair amount of inert so called inert demolition wastes, we have had very little leachate formed and what leachate has been formed has been attenuated almost immediately. If your demolition waste has a fair amount of what you would really consider inert materials, say a fair amount of cement, a fair amount of stone or gravel or that type of material then obviously you have a rather natural system and you don't have any concern. I don't think even the amount of wood that we now have in most demolition wastes would pose much of a problem. I would suggest, and it is strictly off the top of my head, that stumps if they are just part of general demolition wastes would be much the same. I don't think it would be a concern. Certainly for practical reasons you go after the things which are of a lot more concern than demolition wastes to start off with.

Question: **(unidentified)** So you just bury it in some hole?

Answer: **(Mr. Rattray)** Well in some cases they don't even go that far. They are simply used as fill material where they want to have fill and eventually they may be covered over. Once they reach the appropriate grade they get covered over and used for either rebuilding or for parkland or whatever is practical.

Comment: **(Mr. MacKenzie)** Again it depends on what the future use of the site is. I showed you those slides this morning of Kitchener and that site is divided into two general areas. One accepts household refuse and the other accepts demolition wastes. The demolition waste area is extremely high and ultimately it is going to be a recreational area, a toboggan run I think. So they keep it separate, and that's generally what has happened, that it is kept separate not because there is any concern of interaction, but because of the anticipated future use of the site, that they are going to build

something on that particular portion of it. It is a lot safer to do it on that than on regular garbage.

Comment: **(Mr. Rattray)** Kitchener is about the size of Moncton. In terms of population.

Question: **(unidentified)** What is wrong with burning stumps and wood?

Answer: **(Mr. Rattray)** What is wrong with burning anything? I suppose you best direct that question to the air pollution people rather than the solid waste people. I guess that if, you are in the middle of some rural location and you have a small amount of material to burn I don't think anyone responsible would suggest that you have to take that to some proper incinerator or some landfill site a long distance away.

Comment: **(Mr. MacKenzie)** I heard a story the other day of a fellow who had a pretty good solution to the problem. He had been burning wood in his backyard and the Provincial people came after him and gave him hell and said that he couldn't burn it in the backyard and had to truck it away. It was mostly tree stumps and cut up wood so he took it in the house and burned it in the fireplace.

Comment: **(unidentified)** The reason I ask this is that it seems strange to me that the city dump was told to stop burning wood. And yet the very people who complained about it were the first ones to go out in the woods and start a camp fire and usually start forest fires as well. They see nothing wrong with the smell of wood in their fireplace or in a campfire and yet they are the first ones to jump up and down when the city or village burns wood within their community.

Comment: **(Mr. Rattray)** Burning wood in a landfill site is a bit different from burning wood in your backyard.

Question: **(unidentified)** Why?

Answer: **(Mr. Rattray)** Well mostly because of the potential concern that if you ever started your landfill site on fire you would have an horrendous problem on your hands.

Question: **(unidentified)** Well if it was a proper landfill site with no cardboard, no paper, there would be no problem would there?

Answer: **(Mr. Rattray)** Why would you burn it then? If you had a proper landfill site there would be no need to burn it.

Comment: **(unidentified)** No, what I was saying is that you can recycle cardboard, you can recycle glass, tin cans, numerous things.

Comment: **(Mr. Rattray)** Theoretically, yes.

Comment: **(unidentified)** Not theoretically, you actually can, and it is done.

Comment: **(Mr. Rattray)** Yes.

Comment: **(unidentified)** It is done in Kitchener. It is done in British Columbia. In the Saanich Peninsula which I assume you were talking partly about this morning.

Comment: **(Mr. Rattray)** Yes, I say theoretically. Anything can be done for a price. I guess we will have a fair session on that this afternoon, when we get into the resource recovery question. It is a question of economics, I guess. Ray you may want to address the question of burning wood in a landfill site. It seems to me, for what you might gain out of doing it, it has a lot of drawbacks, that just don't make it worthwhile.

Comment: **(Mr. R. Benoit)** From the Provincial point of view, air pollution is the main question. If it is in the city and not too far in you might have smoke and quite massive air pollution, smoke and odour and so on. The other is a safety hazard. It is quite dangerous. It might spread to nearby woods and so on. So there are two things. It has to be under control and if it is left there burning it can go uncontrolled and so there are various reasons for not doing it.

Question: **(unidentified)** Has any work been done on the synergistic effect of chlorination on leachates? Take a hypothetical case, that leachate does get into your water table and it is being consumed as potable water and we tend to chlorinate suspect water to make it pure. If this did happen, the chlorinated water which contained leachate is it compounding the problem?

Answer: **(Mr. Rattray)** First, when we chlorinate water supplies for potable drinking purposes it is not the same thing as ending up with a chloride residual as the result of chlorides getting into a landfill site and hence into the leachates. It is a different situation. I am not aware of any specific work related to the synergistic effects of chlorides and leachates as you perhaps are aware of the recent work with chlorides in water supplies. The work that has gone on has related chlorides or chlorinated hydro-carbons to carcinogenic materials. All I do know is that there are synergistic effects that we are not quite certain about as far as leachates are concerned. Work that has been done on fish toxicity is quite preliminary, but it does suggest that there are some pretty toxic materials, at least in fish, in leachates and at reasonably low concentrations - lower, seemingly than the constituent materials by themselves and these would be the same fish species. Why, we don't know. We are working on it.

Comment: **(unidentified)** You mentioned that leachates could be taken to a sewage treatment center.

Answer: **(Mr. Rattray)** Yes.

Question: **(unidentified)** Does that actually have any effect on leachates or is that just a way of putting it out into Mother Nature?

Answer: **(Mr. Rattray)** I will assume that you mean, put it into a sewage treatment system that has in fact a biological treatment plant as opposed to just dumping into the sewer.

Comment: **(unidentified)** Yes.

Answer: **(Mr. Rattray)** Because dumping it in the sewer does not do any good. If you put it into the sewage treatment plant naturally it does some good. It goes through the same route as the normal sewage, namely degradation of the organic, biologically degradable fractions. Your comment is valid if you talk about the inorganic fractions that are there. The inorganic fractions are either going to end up going out into the receiving stream, much diluted mind you, or they are going to have to be taken out as a sludge and put back into the land. Because the sludge has got to go somewhere as well.

Question: **(unidentified)** Would it remain in the sludge or would it be put in the water?

Answer: **(Mr. Rattray)** Yes, it has to go one of two ways, it doesn't disappear. The inorganic species either goes back with the sludge or goes out into the water.

Comment: **(unidentified)** So you might as well just dump it in the river.

Answer: **(Mr. Rattray)** Not necessarily. You may have a much greater dilution effect. Keep in mind that all of these substances that are coming out of landfill sites, all of these inorganic species are naturally occurring elements. We are not creating new elements. Not in the inorganic field, in any event. They are there. Their concern is a question of concentration. So, yes, there is a difference. A very definite difference.

Question: **(unidentified)** Is there a problem, if we put it through a sewage treatment plant, as well as anything that goes through a sewage treatment plant, with the nutrient that comes out the other end?

Answer: **(Mr. Rattray)** Well it depends on the sewage treatment plant and whether it is primary, secondary or tertiary treatment, as to what actually does come out the other end. That work that has been done suggests that it is biologically degradable, it doesn't upset a sewage treatment plant. Mind you, generally speaking you are talking small concentrations relative to the amount that would go through a normal sewage treatment plant. So if you are talking one or two holding tank trucks a day or whatever, from a population of 10 to 20 thousand, something in that order of magnitude, then you bleed that into your sewage treatment system and it becomes very small, in terms of the total flow, so it doesn't upset the system.

Question: **(unidentified)** I don't know what the total population of the Fredericton sewage system going in here is. I have been told and it is strictly hearsay that the nutrient that comes out the outlet into the Nashwaak River is becoming very harmful to our fish life. Is this a possibility? Is this a complete treatment plant or is this a partial plant?

Answer: **(Mr. Rattray)** I don't know. I am sorry I can not answer your question. I just don't know the local situation. I just know that it is being done elsewhere with a fair amount of success. It is certainly better than letting it go into the stream.

SMALL SANITARY LANDFILLS: OPERATION

Mr. R.C. MacKenzie

SANITARY LANDFILL OPERATION

The best designed disposal facility will be of little value unless it is constructed and operated as prescribed. This is especially true of a sanitary landfill because it is under construction up to the day the last particle of solid waste is disposed of. Constructing the sanitary landfill on a daily basis in accordance with the design should be unequivocally required in an operations plan.

An operations plan is essentially the specification for construction and it should contain all items required to construct the sanitary landfill. It should describe: (1) hours of operation; (2) measuring procedures; (3) traffic flow and unloading procedures; (4) designation of specific disposal areas and methods of handling and compacting various solid wastes; (5) placement of cover material; (6) maintenance procedures; (7) adverse weather operations; (8) fire control; (9) litter control; (10) salvaging operations, if permitted.

Proper operation calls for drawing up a comprehensive plan that spells out routine procedures and anticipates abnormal situations. It must also provide continuity of activities even when personnel changes occur. New supervisors and personnel responsible for solid waste disposal must know what is being done at the landfill and why. The plan, must, however, remain open for revision when necessary. Changes should be noted, and the rationale behind them explained. New personnel will benefit from the experience of others, and continuity of operations will be preserved.

Hours of Operation

The hours a sanitary landfill operates depend mainly on when the wastes are delivered, and generally this is done during normal working hours. In large cities, however, waste collection systems sometimes operate 24 hr. a day. In this case, a site should not be located in a residential area. The usual landfill is open 5 to 6 days a week and 8 to 10 hours a day.

The hours of operation should be posted on a sign at the landfill entrance. It should also indicate: what wastes are not accepted; fees charged; and the name, address and telephone number of the operating body (sanitation district or private company). All this information must be kept current. Fees are usually levied on a cost-per-ton basis for large loads and on a fee basis for small amounts brought to the site by homeowners. The sanitary landfill should be open only when operators are on duty. If it is anticipated that waste will be brought to a disposal site at other times, a large container should be placed outside the site entrance.

Weighing the Solid Waste

The efficiency of filling and compacting operations can be adequately judged if the amount of solid waste delivered, the quantity of cover material used, and the volume occupied by the landfilled solid waste and cover are known. (Weighing is the most reliable means of measurement.) These values are also used to determine the density of the fill and to estimate the amount of settlement that will probably occur. Weight and volume data can also be used in designing new landfills and predicting the remaining capacity of currently operating landfills.

Traffic Flow and Unloading

Traffic flow on the site can affect the efficiency of daily operations. Traffic should be allowed to bypass the scale only if it is inoperative. Haphazard routing between the scale and the disposal area

can lead to indiscriminate dumping and cause accidents. Pylons, barricades, guardrails, and traffic signs can be used to direct traffic. Large sites may need posted maps to direct drivers. If separate working areas are established for different types of wastes, signs should be used to direct drivers to the appropriate disposal areas.

Wastes are delivered to a landfill in vehicles that range from automobiles to large transfer trailers. Operationally, they comprise groups that are unloaded manually or mechanically. The two categories are established because of the difference in time it takes to unload them at the working face. If large numbers of manually unloaded vehicles must be handled, special procedures may be necessary.

Mechanically discharging vehicles include dump trucks, packer-type collection trucks, tank trucks, and open or closed body trucks equipped with a movable bulkhead that requires the use of a crawler dozer or loader. These vehicles are capable of rapidly discharging their loads and should be routed directly to the working face without delay.

Manually discharging vehicles take more time to unload and should not be permitted to slow the unloading of vehicles that can discharge mechanically. Many of the drivers will not be familiar with the landfill operation and will require close supervision. If a large number of manually discharging vehicles is involved, a separate unloading area may be necessary to avoid delaying other vehicles.

Scavenging should not be permitted, and no vehicle should be left unattended. Waste should be deposited at the toe of the working face, because it can be compacted better there since it is worked up the slope rather than down. If it is necessary to discharge solid wastes at the top of the slope, as in a narrow trench operation, telephone poles or similar objects should be emplaced to warn drivers that they are near its edge. The unloading area should be as level as practical for dump trucks and other vehicles having high centres of gravity in the raised position.

Handling of Wastes

Wastes come from residences, commercial establishments, institutions, municipal operations, industries, and farms. Some may require special methods of handling and burial. The landfill designer should know all the types that will likely be involved and make provision for their disposal. Materials that cannot be safely buried should be excluded.

Residential, Commercial and Industrial Plant Wastes. These wastes (exclusive of process wastes) are usually highly compactible. They contain a heterogeneous mixture of such materials as paper, cans, bottles, cardboard and wooden boxes, plastics, lumber, metals, yard clippings, food waste, rocks and soil. When exposed, boxes, plastic and glass containers, tin cans, and brush can be compressed and crushed under relatively low pressure. In a landfill, however, these items are incorporated within the mass of solid waste, which acts as a cushion and often bridges, thus protecting the relatively low-strength materials from being crushed under the load of the compaction equipment.

Cushioning and bridging can be reduced and greater volume reduction achieved if the waste is spread in layers less then 2 feet deep and is then compacted by tracked, rubber-tired, or steel-wheeled vehicles that pass over it 2 to 5 times. Solid waste that contains a high percentage of brush and yard clippings requires the expenditure of more compactive effort. If entire loads of these items are received, they should be spread and compacted near the bottom of the cell so that less resilient wastes can be compacted on top.

The equipment operator should try to develop the working face on a slope between 20° and 30°. Waste is spread against the slope, and the machine moves up and down it, thus tearing and compacting the waste and eliminating voids. The equipment operator should make passes until he no longer can detect that the surface of the waste layer is being depressed more than it is rebounding.

Bulky Wastes. Bulky wastes include car bodies, demolition and construction debris, large appliances, tree stumps, and timbers. Significant volume reduction of construction rubble and stumps by compaction cannot be achieved, but car bodies, furniture and appliances can be significantly reduced in volume. A small crawler dozer (110 HP and 20,000 lb or less) has greater difficulty in compacting washing machines and auto bodies than would heavy machines, but some volume reduction can be achieved. Such items should be crushed on solid ground and then pushed onto the working face, near the bottom of the cell or into a separate disposal area. Once in place, most bulky items do not degrade (at least not at a rate comparable to surrounding refuse). Consequently, if bulky items are incorporated into degradable wastes, uneven settlement will result. Special areas for bulky items should be identified on the final plan of the completed site. Even though bulky wastes do not usually contain putrescibles, they should be completely covered at the end of each operating day to eliminate harborage for rats and other pests.

Selected loads of demolition and construction debris--broken concrete, asphalt, bricks and plaster--can be stockpiled and used to build on-site roads.

Institutional Wastes. Solid wastes from schools, rest homes, and hospitals are usually highly compactible and can often be handled in the same manner as residential and commercial wastes and are often delivered along with them. If hospital wastes are delivered separately, they should be spread immediately, compacted, and enclosed with another layer of waste or a cover material because they could contain pathogenic organisms. Pathological wastes are usually disposed of in a special incinerator, but if accepted, they should be buried immediately under 1 foot of cover material.

Dead Animals. Dead birds, cats, dogs, horses and cows are occasionally delivered to sanitary landfills. In general, small animal corpses can be safely disposed of if placed in a landfill along with other wastes and immediately covered. Very large animals are usually dismembered so they can be transported to the disposal site. They are then placed in a pit and covered with 2 feet of compacted soil; this should be graded periodically to avoid ponding and settlement, which could be appreciable.

Industrial Process Wastes. Because of the wide variety of industrial process wastes and their different chemical, physical and biological characteristics, it is difficult to generalize about handling them. The best source of information concerning their characteristics is the industries that produce them. It is extremely important to evaluate the influence of these wastes on the environment. If an industrial waste is determined to be unsuitable for disposal at the landfill, it should be excluded and the respective industries notified. Another important factor is the health and safety of landfill personnel.

Industrial wastes delivered to a landfill may be in the form of a liquid, semi-liquid, films, sheets, granules, shavings, turnings, powders, and defectively manufactured products of all shapes and sizes. Whether or not these are disposed of in the sanitary landfill depends on the environmental conditions of the site and whether or not they are chemically and biologically stable. They should not be allowed to pollute surface water or groundwater.

Liquids and semi-liquids, if deemed safe to place in a landfill, should be admixed with relatively dry, absorbent solid waste or they may be disposed of in a pit well above the groundwater table. The pit should be fenced and the gate locked to prevent unauthorized access; its location should be recorded in the final plan of the completed site.

Films and other light, fluffy, easily airborne materials can be a nuisance at the working face, and they should be covered immediately when deposited there. Spraying them with water may be helpful, but the detrimental effects of adding water should be considered.

Large sheets of metal, plastic or wood can also be nuisances at the working face. The equipment operator should align the sheets parallel to one another. Random placement leads to large voids, poor compaction, and substantial settlement of the completed landfill. Granules, shavings,

turnings, and powders can be health hazards to operating personnel, nuisances if they become airborne, and very abrasive or corrosive to the landfill equipment; they should be covered immediately.

The workers may have to wear face masks, goggles or protective clothing to avoid respiratory, eye or skin ailments.

Defectively manufactured products are delivered to the landfill to keep them off the market. These wastes should be incorporated into the sanitary landfill immediately so that drivers, helpers, and others at the working face are not tempted to engage in scavenging. Doing so would violate the manufacturer's trust and, even more importantly, would expose them to injury.

Volatile and Flammable Wastes. Some wastes, such as paints, paint residues, dry cleaning fluids, and magnesium shavings, are volatile or flammable. They may be in powder, solid, or liquid form, and they usually derive from industrial processing or are commercial wastes. If they are not highly flammable or volatile, they may be admixed with other wastes, otherwise they should be excluded from the fill or quickly disposed of in a separate area at the site. If the latter step is taken, the area should be clearly marked with warning signs, and its exact location recorded in the final plan of the completed site. Under no circumstances should smoking or open flames be allowed in the vicinity of volatile or flammable wastes when they are being disposed of.

Water and Wastewater Treatment Plant Sludges. Dewatered sludges received from water treatment plants and dewatered digested sludges received from wastewater treatment plants can be disposed of at a sanitary landfill. In most cases, they can be placed in the regular part of the fill, but they should be covered immediately. If their moisture content is relatively high, the sludges should be mixed with the other wastes before being covered to prevent localized leaching. Raw sewage sludges and septic tank pumpings should not be disposed of at a sanitary landfill.

Incinerator Fly Ash and Residue. Fly ash is a fine particulate material that has been removed from combustion gases. As more stringent air pollution control regulations are enforced, the quantity of fly ash that must be disposed of is expected to increase. Fly ash may be moist or dry, depending on how it is separated from the gas stream. If it is dry, water may have to be added to it so that it does not become airborne and create a nuisance. Covering should take place immediately. Residue is the solid material that remains after a combustion process ends. The amount of decomposable organics present in incinerator residue varies widely, but few incinerators produce a residue low enough in decomposable organics to allow it to be used as a daily cover material. When the residue dries, the fines can create a dust problem. Because of its moisture and food content, residue may have a foul odour and attract flies, birds and rodents. Residue of this nature should be incorporated into a sanitary landfill.

Pesticide Containers. Pesticide containers may be delivered to landfills in agricultural areas. If they are empty, they can be crushed by the landfill equipment and disposed of along with other solid wastes. If they are full or only partially empty, they should be excluded from the sanitary landfill and stored with proper inspection to avoid environmental contamination, pending final detoxification and disposal by incineration or pyrolysis under carefully controlled time and temperature conditions.

Animal Manure. Another waste originating primarily in agricultural areas is animal manure, which often contains a large amount of hay or bedding. If the waste is not wet enough to flow, it can be placed in the regular part of the fill but should be covered immediately. If the moisture content is high, the manure should be mixed with dry waste and immediately covered.

Radioactive Wastes and Explosives. Landfills do not accept radioactive wastes. If any are detected in a delivery, the operator should isolate the wastes, truck, and driver and contact the proper health authorities. Explosives are rarely delivered to a disposal site, and should be handled with extreme caution when they are. If they are accepted, the operations plan should contain a provision that explicitly outlines handling procedures, and a demolitions expert should be consulted if possible. The exact location

of the waste should be recorded on the final plan of the completed site, and security fencing and warning signs should be erected.

Placement of Cover Material

The operations plan should specify what soils are to be used as cover material, where they are to be obtained, and how they are to be placed over the compacted solid waste. Cover materials used at a sanitary landfill are classed as daily, intermediate, and final; the classification depends on the thickness of soil used. This is determined by its susceptibility to wind and water erosion and its ability to meet certain functional requirements. Guides for using the different classes are determined by the length of time the cover is to be exposed to the elements. In general, if the cover is to be exposed more than 1 week but less than 1 year, intermediate cover should be used. If the cover is to be exposed less than 1 week, daily cover is sufficient, and if the cover is to be exposed longer than 1 year final cover should be used. All cover material should be well compacted.

Daily Cover. The important control functions of daily cover are vector, litter, fire and moisture. Generally, a minimum compacted thickness of 6 inches of soil will perform these functions. The cover is applied to the compacted waste at least at the end of each operating day. If possible, it should be spread and compacted on the top and sideslopes as construction of the cell progresses, thus leaving only the working face exposed. At the end of the operating day, the working face is also covered. No waste should be exposed, and the cover should be graded to prevent erosion and to keep water from ponding.

Intermediate Cover. Functions of intermediate cover are the same as daily cover but include gas control and possible service as a road base. It is applied in the same manner as daily cover, but the minimum compacted depth recommended is 1 foot. Periodic grading and compacting may be necessary to repair erosion damage and to prevent ponding of water. Cracks and depressions may develop because of moisture loss and settlement of the fill, and periodic maintenance is required.

Final Cover. Final cover serves basically the same functions as intermediate cover, but it must also support vegetative growth. At a minimum, 2 ft. of soil should be used, compacted into 6-in. thick layers. Such factors as soil type and anticipated use of the completed landfill may require more than 2 ft.

Grading is extremely important, and grades should be specified in the landfill design. The general topographic layout of the completed landfill surface is attained by carefully locating solid waste cells, but the final cover is graded and compacted to achieve the desired configuration. Water should not be allowed to pond on the landfill surface and grades should not exceed 2 to 4 percent to prevent the erosion of cover material. Sideslopes should be less than 1 vertical to 3 horizontal. Preferably, topsoil from the site should be stockpiled and reserved for placement on top of the final cover. Since the topsoil will be seeded, it should not be highly compacted.

Maintenance

A properly operated sanitary landfill is distinguished from an open dump by its appearance. The effectiveness of pollution control measures also depends on how well the landfill is maintained during construction and after completion.

Dust is sometimes a problem, especially in dry climates and if the soil is fine grained. Dust can cause excessive wear of equipment, can be a health hazard to personnel on the site, and can be a nuisance if there are residences or businesses nearby.

Dust raised from vehicular traffic can be temporarily controlled by wetting down roads with water or by using a deliquescent chemical, such as calcium chloride, if the relative humidity is over 30 percent.

One of the most important aspects of maintenance is litter control. A landfill operator who permits litter to accumulate and spread from the site is open to warranted public criticism. Public acceptance of proposed sanitary landfills will be easier if those under construction are properly maintained. Blowing litter can be kept at a minimum by maintaining a small-size working face and covering portions of the cell as they are constructed. Snow fences can be positioned around the working face to catch blowing paper and plastic, but unique wind problems may make it necessary to fabricate specially designed fencing. All fences used should be portable so that they can be kept near the working face. Personnel should clean up litter periodically every working day, especially near the close of business. The litter should be placed on the working face before it is covered.

Equipment used at a landfill requires regular maintenance, and the operations plan should establish a routine preventive maintenance program for all equipment.

A daily application of cover material prevents problems associated with rats, flies, and birds. These pests are rarely troublesome at a properly operated sanitary landfill.

Rats are occasionally brought in along with the solid waste delivered. When the waste is unloaded the rats seek cover. They are then buried when the waste is spread, compacted and covered. Infrequently, rats escape and seek protection elsewhere. If they then become a nuisance, they should be killed by conducting a baiting program that is supervised by an experienced exterminator.

If fly problems become severe in summer and an insecticide is used, daily application is necessary, because the insecticide particule must impinge on the fly. Application of cover material as the cell is constructed may control flies without using insecticides.

Birds that are sometimes attracted to landfills can be a nuisance, a health hazard and a danger to low-flying aircraft. Various methods have been used to frighten the birds, but the only way to reduce the problem is to make each working face as small as possible and to cover all wastes as soon as feasible.

Weather Conditions

Weather can slow the construction of a sanitary landfill, and the operations plan should provide detailed instructions on how to operate the landfill during anticipated inclement periods.

In freezing weather, the greatest difficulty is obtaining cover material. If the frost penetrates below 6 in., crawler dozers or loaders equipped with hydraulic rippers are needed to loosen the soil. If several soils are available at the site, well-drained soils, not as susceptible to freezing as those that are poorly drained should be reserved for use as winter cover material. If the frost line goes more than 1 ft below the surface, cover material should be stockpiled beforehand.

Rain can cause operational problems. Roads leading from all-weather access roads to the working face can become a quagmire and prevent collection trucks from unloading. Roads leading to the active working area should be passable in any kind of weather. Gravel, crushed stone, and construction and demolition rubble may be applied to the surface. Collection trucks that pick up mud on the site should be cleaned before leaving it to keep them from dirtying the public road system.

Fires

No burning of wastes is permitted at a sanitary landfill, but fires occur occasionally because of carelessness in the handling of open flames or because hot wastes are disposed of. The use of daily

cover should keep fire in a cell that is under construction from spreading laterally to other cells. All equipment operators should keep a fire extinguisher on their machines at all times, since it may be able to put out a small fire. If the fire is too large, waste in the burning area must be spread out so that water can be applied. This is an extremely hazardous chore, and water should be sprayed on those parts of the machine that come in contact with the hot wastes. The operations plan should spell out fire-fighting procedures and sources of water. All landfill personnel should be thoroughly familiar with these procedures.

A collection truck occasionally arrives carrying burning waste. It should not be allowed near the working face of the fill but be routed as quickly as possible to a safe area, away from buildings, where its load can be dumped and the fire extinguished.

Salvage and Scavenging

Salvaging usable materials from solid waste is laudable in concept, but it should be allowed only if a sanitary landfill has been designed to permit this operation and appropriate processing and storage facilities have been provided. All salvage proposals must be thoroughly evaluated to determine their economic and practical feasibility. Salvaging is usually more effectively accomplished at the point where waste is generated or at specially built plants.

Scavenging, sorting through waste to recover seemingly valuable items, must be strictly prohibited. Scavengers are too intent on searching to notice the approach of spreading and compacting equipment, and they risk being injured. Moreover, some of the items collected may be harmful, such as food waste, canned or otherwise; these items may be contaminated. Vehicles left unattended by scavengers interfere with operations at the fill.

EQUIPMENT

There is a wide variety of equipment available for sanitary landfill operations. The types selected will depend on the amount and kinds of solid waste to be landfilled each day and on the operational methods to be employed at a particular site. Since money spent on equipment constitutes a large capital investment and accounts for a large portion of operating costs, the selection should be based on a careful evaluation of the functions to be performed and the cost and ability of various machines to meet the needs.

Equipment Functions

Sanitary landfill machines fall into three general functional categories: (1) those directly involved in handling waste; (2) those used to handle cover material; (3) those that perform support functions.

Waste Handling. The practical and safe disposal of solid waste is the primary objective of a sanitary landfill. Although the handling of solid waste at a landfill site resembles an earthmoving operation, differences exist that require special consideration. Solid waste is less dense, more compactible, and more heterogeneous than earth. Spreading a given volume of solid waste requires less energy than an equal amount of soil.

Because of its size, strength, and shape, solid waste is not as conducive as soils to compaction by vibration. In the main, solid waste is compacted by the compressive forces developed by the overall massive loading of a landfill machine. Since repeated loading of the solid waste improves its compaction, enough machines should be available that 2 to 5 compaction passes can be made during the operating day. If it is not possible to purchase a large machine, spreading the solid waste into thinner

layers and making more passes with a lighter machine may suffice. The optimum number of passes depends on the moisture content and composition of the solid waste.

Cover Material Handling. The excavating, hauling, spreading, and compacting of cover material are similar to other earthmoving operations, such as highway construction. In landfill operations, however, rigorous control of moisture content to achieve maximum soil density is not usually practiced, although it is desirable to wet a very dry soil somewhat to hold down dust and to improve compaction. Sand, gravel, and certain loamy clay and loamy silt soils can be excavated with wheeled equipment.

Support Functions. A sanitary landfill requires support equipment to perform such tasks as road construction and maintenance, dust control, fire protection, and possibly to provide assistance in unloading operations. Road construction and maintenance must be provided so that the working face can be reached in all types of weather. This often requires the adoption of a dust control program which, in turn, may call for the use of special equipment, such as a water wagon and sprinkler or a salt spreader. Mobile firefighting equipment may be stationed on the site or readily available nearby. Assistance in the unloading operation may include emptying collection trucks equipped with a movable bulkhead and pulling out vehicles that become stuck near the operating face during rainy weather. Unless there are many collection trucks requiring assistance, the spreading and compacting machine can handle the situation.

Equipment Types and Characteristics

Crawler Machines. Crawler machines are of two types: dozer and loader.

The crawler dozer is usually fitted with a straight dozer blade for earthwork, but at a sanitary landfill it should be equipped with a U-shaped blade that has been fitted with a top extension (trash or landfill blade) to push more solid waste.

Unlike the crawler dozer, the crawler loader can lift materials off the ground, but its bucket is not as wide, and it is not able, therefore, to spread as much solid waste. A landfill blade similar to that used on dozers can also be fitted to loaders.

Rubber-Tired Machines. Both dozers and loaders are available with rubber-tired wheels. They are generally faster than crawler machines (maximum forward or reverse speed of about 29 m.p.h.) but do not excavate as well. The plausible claim has been made that because the weight of rubber-tired machines is transferred to the ground over a much smaller contact area, they provide better compaction, but significant differences of in-place density have not been proven.

The rubber-tired dozer is not commonly used at a sanitary landfill. Because of the rough and spongy surface formed by compacted solid waste and the concentrated wheel loads, the rubber-tired dozer does not grade as well as a crawler dozer.

The rubber-tired loader is usually equipped with a general-purpose or multiple-purpose bucket. A particular asset of this machine is the high speed and mobility of its operation. When it is only needed part time at a sanitary landfill, it can be driven over public roads to perform other jobs.

Landfill Compactors. Several equipment manufacturers are marketing landfill compactors equipped with large trash blades. The power train and structure of landfill compactors are similar to those of rubber-tired machines, and their major asset is their steel wheels. The wheels are either rubber tires sheathed in steel or hollow steel cores; both types are studded.

Steel-wheeled machines probably impart greater crushing and compactive effort than do rubber-tired or crawler machines.

The landfill compactor is an excellent machine for spreading and compacting on flat or level surfaces and operates fairly well on moderate slopes, but it lacks traction when operating on steep slopes or when excavating. It is faster than a crawler but slower than a rubber-tired machine.

Scrapers. Scrapers are available as self-propelled and towed models having a wide range of capacities. Their prime function is to excavate, haul, and spread cover material. Since they are heavy when loaded, routing them over the fill area will help compact the solid waste. Hauling capacities range from 2 to 40 cubic yards.

Dragline. Large excavations can be made economically with a dragline. Its outstanding characteristic is its ability to dig up moderately hard soils and cast or throw them away from the excavation. Because of this feature, it can also be used to spread cover material over compacted solid waste. It is particularly useful in wetland operations. The dragline is most commonly found at large landfills where the trench method is used or where cover material is obtained from a borrow pit.

Special-Purpose Equipment. Several pieces of earthmoving and road construction equipment are put to limited use on landfills that dispose of less than 1,000 tons a day. Their purchase may not, therefore, be warranted. When they are needed, they can be borrowed, leased, rented, or the work can be performed under contract.

The road grader can be used to maintain dirt and gravel roads on the site, to grade the intermediate and final cover, and to maintain drainage channels surrounding the fill.

Water is useful in controlling blowing litter at the working face and control of dust from on-site roads. Water wagons range from converted tank trucks to highly specialized, heavy vehicles that are generally used in road construction operations. They can also be used at the landfill to fight fires.

The raod sweeper is a real asset at sites where mud is tracked onto the public road system. Its periodic use will encourage local residents to accept the landfill because roadways remain safe.

Size of Operation

Definition of functions and evaluation of equipment performance must be matched with the size of the landfill to determine the type, number, and size of the machines needed. No one machine is capable of performing all functions equally well. Neither can it be assumed that equipment effectively used at one site will be the most suitable elsewhere.

Single-Machine Sites. Particular difficulty is encountered when selecting equipment for a site where only one machine will be used. It must be capable of spreading and compacting both solid waste and cover material, but it may also have to be used to excavate trenches or cover material. In general, the most versatile machine for a small landfill is the tracked or rubber-tired loader. If the machine will not be used full time, a wheeled loader is preferable because of its mobility. If the machine is to stay at the site full time and will not be required to load cover material into trucks, a crawler dozer may be better.

Regardless of the size of a single-machine operation, the dependability of the machine should be high. Arrangements should be made in advance to obtain a replacement if a breakdown occurs, because this development is no excuse for unacceptable disposal. A replacement machine may be made available through the equipment dealer, a local contractor, or a municipal public works department.

Small Sites. Municipalities disposing of less than 10 tons a day may find the cost of owning a small dozer or loader too high. If excavation and stockpiling of cover material are done on contract a farm tractor equipped with a blade or bucket may be sufficient for spreading the solid waste. The tractor will not, however, be able to produce much compaction, even if the waste is spread in thin layers. The poor compaction achieved means that a larger fill area will be needed. This requirement, together with

the total cost of the contract work, should be compared to the expense of owning and operating a small dozer or loader.

Multiple-Machine Operation. It is easier to select equipment for a multiple-machine operation than it is for a one-machine operation. Such specialized machines as scrapers and landfill compactors may then be economical to use. If cover material has been stockpiled and more than one machine is available, operations need not be interrupted when an equipment breakdown occurs. As an added precaution, replacement machines should be available through a lease, contract, or borrowing arrangement.

COMPLETED SANITARY LANDFILL

Reclaiming land by filling and raising the ground surface is one of the greatest benefits of sanitary landfilling. The completed sanitary landfill can be used for many purposes, but all of them must be planned before operations begin.

Characteristics

The designer should know the proposed use of the completed sanitary landfill before he begins to work. Unlike an earthfill, a sanitary landfill consists of cells containing a great variety of materials having different physical, chemical, and biological properties. The decomposing solid waste imparts characteristics to the fill that are peculiar to sanitary landfills. These characteristics require that the designer plan for gas and water controls, cell configuration, cover material specifications (as determined by the planned use), and the periodic maintenance needed at the completed sanitary landfill.

Decomposition. Most of the materials in a sanitary landfill will decompose, but at varying rates. Food wastes decompose readily, are moderately compactible, and form organic acids that aid decomposition. Garden wastes are resilient and difficult to compact but generally decompose rapidly. Paper products and wood decay at a slower rate than food wastes. Paper is easily compacted and may be pushed into voids, whereas lumber, tree branches, and stumps are difficult to compact and hinder the compaction of adjacent wastes. Car bodies, metal containers, and household appliances can be compacted and will slowly rust in the fill with the help of organic acids produced by decomposing food wastes. Glass and ceramics are usually easily compacted but do not degrade in a landfill. Plastics and rubber are resilient and difficult to compact; rubber decomposes very slowly, most plastics not at all. Leather and textiles are slightly resilient but can be compacted; they decompose, but at a much slower rate than garden and food wastes. Rocks, dirt, ashes, and construction rubble do not decompose and can be easily worked and compacted.

Density. The density of solid waste in a landfill is quite variable. One that is well constructed can have an in-place density as great as 1,500 pounds per cubic yard, while that of poorly compacted solid waste may be only 500. Generally, 800 to 1,000 pounds per cubic yard can be achieved with a moderate compactive effort. Soft and hard spots occur within the fill as a result of different decompostion rates and compaction densities. Density influences such other characteristics as settlement and bearing capacity.

Settlement. A sanitary landfill will settle as a result of waste decomposition, filtering of fines, superimposed loads, and its own weight.

The most significant cause of settlement is waste decomposition, which is greatly influenced by the amount of water in the fill. A landfill will settle more slowly if only limited water is available to decompose the waste chemically and biologically.

Settlement also depends on the types of wastes disposed of, the volume of cover material used with respect to the volume of wastes disposed of, and the compaction achieved during construction. A fill composed only of construction and demolition debris will not settle as much as one that is constructed of residential solid wastes. A landfill constructed of highly compacted waste will settle less than one that is poorly compacted.

Settling can produce wide cracks in the cover material that expose the wastes to rats and flies, allow water to infiltrate and permit gas to escape. Differential settling may form depressions that permit water to pond and infiltrate the fill. Settling may also cause structures on the landfill to sag and possibly collapse; the underground utility lines that serve these buildings or traverse the site may then shear. Because every landfill settles, its surface should be periodically inspected and soil should be added and graded when necessary.

Bearing Capacity. The bearing capacity of a completed sanitary landfill is the measure of its ability in pounds per square foot to support foundations and keep them intact. Very little information is available on the subject, but a few investigators place the bearing capacity of a completed landfill between 500 and 800 pounds per square foot.

Landfill Gases. Landfill gases continue to be produced after the landfill is completed and can accumulate in structures or soil, cause explosions, and stunt or kill vegetation. Placement of a thick, moist, vegetative, final cover may act as a gas-tight lid that forces gases to migrate laterally from the landfill.

Corrosion. The decomposing material in a landfill is very corrosive. Organic acids are produced from food, garden, and paper wastes, and some weak acids are derived from ashes. Unprotected steel and galvanized pipe used for utility lines, leachate drains, and building foundations are subject to severe and rapid pitting. All structural materials susceptible to corrosion should be protected. Acids present in a sanitary landfill can deteriorate a concrete surface and thus expose the reinforcing steel; this could eventually cause the concrete to fall.

Uses

There are many ways in which a completed sanitary landfill can be used; it can, for example, be converted into a green area or be designed for recreational, agricultural, or light construction purposes. The landfill designer should evaluate each proposal from a technical and economic viewpoint. More suitable land is often available elsewhere that would not require the expensive construction techniques required at a sanitary landfill.

Green Area. The use of a completed sanitary landfill as a green area is very common. No expensive structures are built, and a grassed area is established for the pleasure of the community. Some maintenance work is, however, required to keep the fill surface from being eroded by wind and water. The cover material should be graded to prevent water from ponding and infiltrating the fill. Gas and water monitoring stations, installed during construction, should be periodically sampled until the landfill stabilizes. Gas and water controls and drains also require periodic inspection and maintenance.

If the final cover material is thin, only shallowrooted grass, flowers, and shrubs should be planted on the landfill surface. The decomposing solid waste may be toxic to plants whose roots penetrate through the bottom of the final cover. An accumulation of landfill gas in the root zone may interfere with the normal metabolism of plants. This can be avoided by selecting a cover material having a low waterholding capacity, but this type of soil provides poor support for vegetation. On the other hand, a moist soil does not allow decomposition gas to disperse and consequently gas venting must be considered.

Agriculture. A completed sanitary landfill can be made productive by turning it into pasture or crop land.

If cultivated crops are used, the final cover should be thick enough that roots or cultivating do not disturb its bottom foot. If the landfill is to be cultivated, a 1- to 2-foot layer of relatively impermeable soil, such as clay, may be placed on top of the solid waste and an additional layer of agricultural soil placed above to prevent the clay from drying out. Excessive moisture will also be prevented from entering the fill. Such a scheme of final cover placement must also provide for gas venting via gravel trenches or pipes.

Construction. A foundations engineering expert should be consulted if plans call for structures to be built on or near a completed sanitary landfill. This is necessary because of the many unique factors involved--gas movement, corrosion, bearing capacity, and settlement. The cost of designing, constructing, and maintaining buildings is considerably higher than it is for those erected on a well-compacted earth fill or on undisturbed soil. The most problem-free technique is to preplan the use of islands to avoid settlement, corrosion, and bearing-capacity problems. Ideally, the islands should be undisturbed soils that are bypassed during excavating and landfilling operations. Settlement would then be governed by the normal properties of the undisturbed soil. Alternatively, truck loads of rocks, dirt, and rubble could be laid down and compacted during construction of the landfill at places where the proposed structure would be built.

The decomposing landfilled waste can be excavated and replaced with compacted rock or soil fill, but this method is very expensive and could prove hazardous to the construction workers. The decomposing waste emits a very putrid smell, and hydrogen sulfide, a toxic gas, may be present with methane, an explosive gas. These two gases should be monitored throughout the excavating operation. Gas masks may have to be provided for the workmen, and no open flames should be permitted.

Piles can also be used to support buildings when the piles are driven completely through the refuse to firm soil or rock.

Several peculiar problems arise when piles are used to support a structure over a landfill. The decomposing waste is very corrosive, so the piles must be protected with corrosion-resistant coatings. It may be very difficult to drive the piles through the waste, if large bulky items, such as junked cars and broken concrete, are in the fill where the structure is to be located. The fill underlying a pile-supported structure may settle, and voids or air spaces may develop between the landfill surface and the bottom of the structure. Landfill gases could accumulate in these voids and create an explosion hazard.

Recreation. Completed landfills are often used as ski slopes, toboggan runs, coasting hills, ball fields, golf courses, amphitheaters, playgrounds, and parks. Small, light buildings, such as concession stands, sanitary facilities, and equipment storage sheds, are usually required at recreational areas. These should also be constructed to keep settlement and gas problems at a minimum. Other problems encountered are ponding, cracking, and erosion of cover material. Periodic maintenance includes regrading, reseeding, and replenishing the cover material.

"SANITARY LANDFILL"

Videotape Narrative

Introduction

This presentation will illustrate some of the engineering principles and practices that are required in a properly planned and operated sanitary landfill. We shall examine in some detail the daily operations of Toronto's Beare Road Sanitary Landfill.

The Public Works Department of the Municipality of Metropolitan Toronto operates two sanitary landfill sites. Together they are accepting well over 800,000 tons of refuse per year.

The Beare Road Sanitary Landfill site, the larger of the two, occupies 194 acres and is located East of Scarborough and North of Highway 401.

Daily Operations

Vehicles carrying refuse are weighed upon entering the site at the scale house. The weighscales are located far enough away from the main entrance to ensure trucks do not interfere with traffic on the public highway.

If the refuse truck is owned by one of the constituent municipalities the weigh-master records the gross weights on a special form which is then used in the billing process for the respective municipality.

Private collection vehicles may pay in cash or use a charge account system. At the time of leaving the site, private vehicles are reweighed and given a receipt. Municipal vehicles are not weighed when leaving because their tare weights are recorded every three months, and corrected if necessary.

Private cars, trailers and pick-up trucks, up to 1/2 ton, are permitted to use the site free of charge.

The access road from the public highway to the working area, a distance of about one mile, is paved, with a posted speed limit of 40 miles per hour.

The landfill site is located about 3 1/2 miles from Highway 401. Roads leading from 401 to the landfill site are patrolled daily to ensure that any debris which may have fallen from refuse vehicles is collected and delivered to the site.

All refuse brought to the site is dumped at the working face. Normal municipal refuse is usually placed at the top of the face and the bulky material is dumped at the bottom.

Refuse is delivered to the site six days a week. 12,000 tons of solid waste per week are brought to the Beare Road site for disposal.

Two 25 ton bulldozers compact the refuse by continually moving up and down the working face.

When completed, each refuse cell has an average depth of eight feet. Daily cover consists of nine inches of well compacted, clean fill.

Cover material is brought to the face throughout the entire day so that none of the vehicles will be required to travel over uncovered refuse.

Soil for cover material is excavated by a 2 cubic yard dragline and transported to the working face by dump trucks. Self-propelled scrapers are also used to bring cover material to the face.

Sufficient quantities of fill material are kept at the working face at all times to minimize odours, and blowing papers and reduce fire hazards.

Works department personnel, stationed at strategic locations near the working face, direct traffic to the exact location for dumping and issue violation notices to those truckers who disobey the site regulations.

Those regulations include:

1. liquid wastes are not accepted at the working face;
2. the site supervisor must give prior approval to the dumping of solid waste which may be hazardous;
3. loads entering the site must be fully covered by tarpaulins or other suitable means;
4. all loose material must be emptied from truck boxes before leaving the site;
5. unloading is restricted to authorized areas only;
6. smoking is prohibited in the dumping area;
7. scavenging is prohibited.

In addition to these regulations, truckers are required to use only designated access routes to the site and to obey all signs and speed limits posted on the site.

An area has been set aside for individuals bringing in their own refuse by car or pick-up truck. Four 30 cubic yard roll-off boxes have been placed in an area separate from the working face. This eliminates any interference which might result if private vehicles were allowed into the primary working area.

Limited volumes of liquid wastes are accepted for disposal at the Beare Road Landfill. The limit is set at 5% by weight of the solid waste entering the site.

As required by the regulation, hazardous wastes are only accepted if they have received prior approval from the supervisor and if adequate cover material is available. These wastes, including pathological wastes, are received only at the end of the working day.

Environmental Quality Control

Leachate is controlled by an under drainage system of five inch diameter spiral metal pipes which conduct the leachate to a central collection pond. The pond is 60 feet by 90 feet and six feet deep. The contents of the pond are recycled back into the fill on an average of once a week.

Water quality monitoring wells located in the perimeter ditch, are sampled once a month. Selected nearby residential wells are also monitored for water quality.

Monitoring for methane gas generation is also carried out, particularly during the winter months when frost action makes the gas travel laterally through surrounding ground.

Good all-weather road conditions are essential for a dependable operation. To assist in the construction of temporary access roads to the working face, incinerator ash and residue from other Metro facilities are used as the road-base material. In addition, crushed stone is placed on the access roads when they become muddy.

Control of blowing paper is one of the most difficult problems. Partial solutions have been found by using netting and snow fencing. Paper and other debris from around the site perimeter are collected twice a week.

Vector control is provided by a private exterminator. The site is monitored on a weekly basis.

Equipment

The equipment kept at the site includes five 25 ton crawler-type bulldozers equipped with special landfill blades. Two units are equipped with rippers for winter work.

Bulldozers are kept in a fenced compound which is illuminated during the night. The compound is adjacent to the site office and maintenance shop, where routine repairs are made.

Other items of equipment used on this landfill site are:

- 1 Front-end loader
- 1 Street Sweeper, used to clean paved access roads
- 1 Grader used for road work and to finish intermediate and final grades of the landfill proper
- 1 Tank truck used to wash paved roads, to deliver water to the site and to water landscaped areas planted with grass and trees
- 2 Scrapers, one of which is self-loading, which are used to excavate and haul clean cover material
- 1 2 cubic yard Dragline used for perimeter ditch work and the excavation of cover material
- 3 Tandem dump trucks to haul clean fill
- 2 Pick-up trucks used by the foremen.

Personnel

Personnel at the site work on a staggered-hours basis to ensure that maximum manpower is availalbe on site during peak delivery times.

The staff required for six-day operation include:

1 Supervisor
2 Foremen
3 Weighmasters
3 Heavy equipment operators to operate the front-end loader, the tank truck, the sweeper and the grader
2 Truck drivers
1 Maintenance man to make minor repairs to small equipment
5 Men to control traffic on the site
8 Bulldozer operators who operate the 25 ton bulldozers and the scrapers
1 Crane operator who operates the 2 cubic yard dragline
5 Labourers
and 1 Site clerk

Site Development

When a section of the landfill has reached the final designed elevation a four foot cover of earth is placed over it. The final cover is comprised of an additional eight inches of top dressing suitable for growing grass.

This top dressing material is prepared by composting a mixture of leaves and dewatered, digested sewage sludge.

Efforts to grow grass on the finished cover have been successful and, in fact, shrubs and trees have also flourished.

The slopes at the site are a maximum of 4 horizontal to 1 vertical with a minimum grade of 1.5% at any point.

Contouring, included in the planning process, gives the finished site a natural appearance and makes it more acceptable to those who will maintain it and possibly use it for other purposes in the years to come.

"SOLID WASTE UTILIZATION"

Videotape Narrative

Introduction

The recovery of reusable materials from solid waste is not a new concept. The subject is, however, presently experiencing a higher degree of interest.

This presentation will examine the procedures currently used to recover some commodities from industrial and municipal solid waste, firstly glass containers.

Glass Recycling

The major source of waste glass, or cullet, continues to be discontinued stocks or returnable soft drink bottles shipped by bottlers to glass manufacturing plants.

Recently, another source has been glass collected during bottle drives sponsored by various civic-minded groups.

One example of support for such a venture has been the once-a-month curbside collection of glass bottles in the community of Kanata, Ontario.

Since January, 1972, householders have sorted their glass containers by colour and removed from them all metal and plastic components. The cullet is collected by municipal crews and delivered to a central processing depot where it is crushed.

The glass is deposited into a home-made bottle crusher which is placed on top of a 20-cubic yard roll-off container. One roll-off container is used to accept clear glass, while a second container has two compartments which separately receive green and amber glass.

When the roll-off containers are filled, they are hauled approximately 170 miles to Montreal where the glass is currently purchased for $15.00 per ton by the Dominion Glass Company.

The cullet represents approximately 30% of all raw materials used in the manufacturing process. According to Dominion Glass, 1/6th of the cullet is supplied by groups like the one in Kanata.

The cullet is transported by a front-end loader to a hopper which feeds a jaw-crusher. The crushed cullet, which the industry believes could eventually represent up to 50% of the raw material mix, is conveyed to a mixing area where silica, soda ash, limestone and the cullet are mixed and automatically charged into the furnace.

The molten glass, which reaches a temperature of 2,800 °F, flows out of the furnace through a ceramic ring called a "gobber". This device shears the molten mixture into a "gob" which contains exactly the right quantity of glass to make the style of container being produced.

The gob slides down a chute into a blank mold where a puff of air forms the glass into a miniature version of the final bottle. It is then transferred into the finishing mold where compressed air blows it into its final shape.

The finished container joins a procession of similar bottles which pass through the "lehr"--a long tunnel-like oven which reheats and tempers the bottles whilst gradually cooling them from 1,000 °F to room temperature.

Automatic inspection machines electronically check the top and bottom sections of each container. If the container is not satisfactory, it is rejected and returned to the pile of cullet where, once again, it begins its trip through the process.

Metal Container Recovery

The recovery of reusable materials from bi-metal containers is presently limited to a process which removes the tin coating from steel bodied cans and other similar products. The de-tinned steel is sold as high quality scrap to steel manufacturers. After conversion to a plating compound, the tin is reused to coat new steel products.

The only plant in Canada which is engaged in this process is M & T Products in Hamilton, Ontario.

The major sources of cans or tin-coated ferrous scrap subjected to this process are can manufacturers or other metal fabricators. In addition, cans which have been sorted from household refuse are purchased from selected citizens' groups who are involved in environmental matters. Carload quantities are generally placed in a container set aside for this purpose. Recently, a contract was signed with the City of Hamilton, to supply ferrous metal recovered from household refuse received at the East Hamilton Solid Waste Reclamation Unit.

Scrap that is to be de-tinned is transferred by an overhead electro-magnet into a large, perforated drum or basket. Each basket can hold 6 to 7 tons of flat scrap or about 2 tons of cans.

The basket and contents are immersed in a solution of sodium hydroxide. The caustic removes the tin from the steel and produces insoluble sodium stannate which is later removed from the liquid.

The basket of treated scrap is drained and transferred to an unloading area where the basket is opened. From here, the metal is transferred by an overhead electro-magnet to a baling machine which produces bales weighing about 550 pounds. The bales are transferred to a gondola car and shipped to steel plants.

The M & T process can accept a limited number of aluminum ended tri-metal cans. The aluminum consumes the caustic de-tinning solution at a much faster rate than tin does which means the chemicals must be changed more frequently.

Whenever a truckload of substantially tri-metal cans arrives, the cans are not de-tinned, but instead they are baled and sold to the steel companies as low grade scrap.

The insoluble sodium stannate that is produced in the de-tinning bath is used to produce another by-product. It is initially treated with acid and then with potassium hydroxide to produce potassium stannate. This material is marketed in powder form and sold as a tin-plating compound.

Scrap Metal Recovery

Until recently, scrap dealers have relied upon somewhat unsophisticated sorting techniques to prepare various types of metal commodities for resale. After separation, these materials were usually baled and sold as scrap of various grades.

Through the years improved techniques have evolved. One, a shredding process, allows ferrous metals to be magnetically separated more readily from non-ferrous metals and other materials producing a scrap which can be over 99% ferrous metals.

One typical installation is designed by the Newell Company of San Antonio and is owned by Intermetco in Hamilton, Ontario.

The shredder is used almost exclusively to process junk autos, 20% of which are imported from New York State. Normally, the automobile hulks delivered to Intermetco come to the plant within a 100 mile radius of Hamilton.

Prior to delivery, gas tanks, tires and upholstery are removed and the cars partially flattened.

Hulks are transferred by an overhead crane to the deck of a tilting hopper. When the hopper is raised, the auto slides into the hammermill. Inside the mill, steel hammers rotating at high speed, pulverize the auto into small fragments.

The auto is reduced to three types of materials: ferrous metals, non-ferrous metals and dirt, the latter being the remains of upholstery, rubber and plastic components. The dirt is removed by an air separation or vacuum system.

Ferrous and non-ferrous metals are separated from each other on two electro-magnetic drums. The recovered non-ferrous metals amount to about 1 or 2% of the original auto.

The ferrous scrap is transported by a conveyor belt which carries it through a rotary kiln. Here any remaining traces of combustible material are burned off.

The ferrous metal undergoes one final magnetic separation before it travels up an inclined conveyor which drops it onto a pile of scrap. An overhead magnet transfers the scrap to railroad cars which transport the metal to steel plants.

Installations of this type can process from 15 to 60 tons per hour or 1000 to 6000 tons per month.

More details on the Canadian ferrous scrap situation are available in the publication:

The Utilization of Ferrous Scrap in Canada

which was produced for the Solid Waste Management Branch of Environment Canada. Copies are available on request.

Waste Paper De-Inking

The Abitibi Provincial Paper Company in Thorold, Ontario is presently the major Canadian paper mill which uses de-inked pulp in the manufacture of fine paper products. Paper manufacturers and institutions such as banks and office buildings are the major sources of the paper used by Abitibi's de-inking process. Post-consumer household paper waste is not used.

De-inking Process

The large bales of paper are transported to cooking tanks where the action of water, heat and caustic reduces the paper to a pulp and liberates the ink which remains dispersed throughout the

pulp mixture. The pulp is then subjected to a series of screening procedures to remove the ink and other contaminants.

The pulp slurry, which is now about 3 to 5% solids, is fed into the bottom of a four-storey high chlorinator. From there, it passes into a hypo-chlorite bleaching tower, where it remains for about 1 1/2 hours at constant temperature.

The bleached slurry is once again screened, this time on vibrating flat screens, which remove oversized or foreign materials.

The pulp, and any remaining ink, passes through cyclone cleaners which direct ink and other material heavier than water out the bottom while the pulp slurry comes to the top. The cyclones are arranged in banks to provide primary, secondary and tertiary treatment, if necessary, to remove the ink.

The de-inked slurry is then thickened on horizontal, rotating vacuum filters, after which it is conveyed to the paper making process.

Presently, the de-inked wastepaper represents from 30 to 40 percent of the total fibre used in the mill to produce fine paper.

RESOURCE RECOVERY

Mr. T.E. Rattray

Gentlemen, I realize that for many of you resource recovery, recycling, whatever we want to call it is but a frustration. I share your frustrations, but perhaps for different reasons. Resource recovery is something that certainly seems very rational yet when you look at the bottom line of your financial sheet it always ends up coming out in the red. There are reasons for this paradox and I'll attempt to expand on them; not necessarily agreeing with them but they are a fact of life at this particular point in time.

I had originally planned to discuss with you a number of the national issues, on various material sectors and the implications of recycling or not recycling. We did discuss them once before in Halifax and many of you were there. In reality these issues mostly apply, certainly as far as central processing facilities, to Montreal, Toronto and Vancouver. These are in fact the population centers, these are the centers that offer the economies of scale for central processing of municipal solid wastes and in many cases industrial solid wastes. But of course, most importantly, they are the areas where the largest markets for the recovered materials are, simply because that's where most of the industry is. On that kind of negative note you may wonder why I'm here discussing the subject.

Firstly, I'm here because I think the subject is important, I think it's important to all Canadians and I hope that the Federal Government can move in the direction that will in fact bring about greater resource recovery throughout the country. Secondly, since the Halifax seminar there have been a number of developments in the resource recovery area that I would like to mention to you. And lastly I would like to tell you what our current thinking is on resource recovery within our Branch, what we hope to do in the forthcoming year, and thereafter, so, let's have a look at some of the specifics of resource recovery.

No doubt at this particular time the downturn of the economy in Canada and the United States and, I guess in other countries as well, has had a significant negative effect on resource recovery, certainly in the past year. We have gone from a boom situation in mid '74 to a bust situation. This was certainly reflected by the people who attended the Canadian Association of Recycling Industries Annual Conference this week in Ottawa. I had a good chance to discuss with a lot of these people the current situation and believe me it is not very attractive. But then it is not very attractive for the primary industries either. I guess recessions are not favorable times for many people at all. Certainly that which was taking place in 1974 in the way of recycled materials is not taking place now. A lot of the materials that were being recycled then are now going to landfill.

You have to ask the question "why?" Is it simple economics? Is it over supply? Did many people get on the band wagon because it looked good in mid 1974; or is it under demand, or is it both and why? Well if we look at some sectors in the Canadian Steel Industry as an example, to date in 1975 we have had a slowing down in the steel industry and generally speaking that slowing down has not been nearly as dramatic as it has been in the United States. As a result the industry, the steel industry in this country is still paying a reasonable price for ferrous scrap. At the same time the United States has lifted its export controls that it had in place from July of '73 until a few months ago. Since those controls have been lifted it has all of a sudden meant a new supply of ferrous scrap to the Canadian steel mills and it has forced the price down. Certainly in this particular sector it appears to be a situation now where we are into over supply. It is not necessarily of course the total doing of the Canadian industries, but nonetheless from the consuming mills' point of view there is lots of scrap coming their way.

I might mention something about the derelict automobile programs in operation across the country. With the exception of one province, I believe all provinces either have at this point operational or at least planned some form of provincial program to collect derelict automobiles. Most programs that

I refer to subsidize either the collection or the transportation of the automobiles especially or particularly those from remote areas of the provinces. I guess it points out an interesting point. If economics are made to be right by the intervention of governments, materials can, in fact, and do, in fact, flow. In other words in the case of the automobile certainly it is not a technological problem at all. If the money is there for the material it will flow.

There are a couple of other programs that we are interested in, and other people are interested in as well, involving ferrous wastes. You have magnetically separated municipal ferrous wastes, at this particular point in time being handled in both Hamilton and Montreal incinerators. In the Hamilton incinerator prior to incineration and in Montreal after incineration. In the case of the Hamilton incinerator the videotape that you just saw illustrated that it was in fact in most cases going to the de-tinning plant and then on to Stelco. In the Montreal case after incineration and some manual upgrading the material goes to the Gaspe Copper Mines and is used in the copper precipitation process.

In our Branch in the Federal Government we have planned a few projects in this particular area. (See Table 1). You will see from Table 1 that the principal distribution in terms of percentages for the steel that is used in North America is in the transportation industry and again principally within the automobile industry, and as a result we have of course the automobile programs that are underway now. What we would like to look at is that segment which is non-auto in terms of the ferrous materials. Firstly what is it, and where is it, and what would it cost to get it moving to the consuming steel mills? There may be technological problems, there may be simply economic problems. We would like to look at some of these problems so we have a study lined up in that regard.

We would also like to look at a subject that is of particular interest to I am sure most of you people here who are involved in resource recovery. Namely the impact of freight rates on the movement of both secondary ferrous and secondary paper materials. I would like to point out to you that it is such that it is not sufficient to demonstrate that there is discrimination between primary and secondary materials. I've been told quite clearly that there is discrimination between bananas and apples and discrimination between gum and cars. There is no uniform rate setting as far as materials go. The Federal Government's involvement of course through the Canadian Transportation Commission is such that it sits and hears recommendations for freight rate increases, decreases or what have you and on that basis it has some impact but it does not itself set the freight rates. CN, CP and some of the provincial railroads are, in fact, the people who set the freight rates, and they are at liberty to get whatever they can from them. So if there is discrimination for some commodities it may not be so for others. I am talking now primary vs. secondary. We must show the discrimination and we must show that it has an impact, a significant impact on what is in fact moving or what is not moving. Only in that respect are we going to have a case with CTC.

Regarding the non-ferrous fraction from automobile shredding, I believe the figures were 1 to 2%. I think that figure is higher now. But the non-ferrous fraction from the automobile shredding unit is a material that seems to have a lot of promise as far as recovery. So, we are looking at upgrading technology in the recovery economics for this particular fraction. There are a lot of shredders now in the country and I think it is time we looked at the possibility of recovering even more from the auto shredding operation.

I would like to mention one thing that is perhaps a little more positive in terms of the steel industry. This (Figure 1) is a graph that illustrates the surplus of ferrous scrap in the United States and it is in five year segments going from 1960 thru 1990 and I think if you look at it, the cross-sections all the way through from 1960 to 1990, obviously projections in the future, illustrate that the United States is in the position of net supply. That is to say they have an excess of scrap over that which would be required for their steel mills. The situation for Canada is not the same at all. The approximate surplus that is available in Canada is only available, in one five year segment '65 to '70 and all the projections that we have up to 1990 suggest that based on the current growth of the Canadian steel industry there

is going to be a net deficit of scrap in this particular country. (See Figure 2). What that means is if we can manage to get the ferrous material from wherever it might be, from the old wood sheds, from the mines, from the pulp mills, from wherever and we can economically bring it to the steel mill, they will, in fact, be able to consume it. It is not such that we are going to have so much of it that they can not use it because their use is limited for technological reasons to certain quantities. But certainly as far as Canada is concerned there is capacity for taking that steel if we can economically get it to the mills.

The world situation, and I say world situation because as you are aware the Canadian steel industry or Canadian industries, most of them, much more so the paper industry, is very much tied to the international market place. The paper industry in Canada is really most dependent on exports principally to the United States. We export 70 odd percent of our total paper and in certain segments we export larger percentages. The slowdown in the economy has hit hard in the secondary wastepaper industry. At this particular point in time you can not give away newsprint in some locations in the country and I'm sure many of you are well aware of that. The newsprint collection systems that have been in operation in some centers in the country, that is to say those that involve bins in the back or sides of packer trucks, I think have demonstrated reasonably well that you can efficiently collect the newsprint if in fact you can market it.

In this respect perhaps we could have a look at the paper industry and where the materials go. This is a table of products from waste paper:

Product from Wastepaper	% of Total Fibre Recycled
Paperboard	81
Building Paper and Board	10
Printing and Fine Paper	4
Wrapping, Tissue and Others	5
	100

You see by far the largest percent of the total is in the paper board industry. Certainly in as far as waste newsprint is concerned in Canada most of it goes to the paper board industry, with a small amount going into building paper and board. Nothing goes into printing fine paper, nothing into wrapping tissue and other such paper, simply because the fibres involved in waste paper are of course mechanically ground with pulps and they just can not use them. What it does mean is that the markets for newsprint are finite as far as this country is concerned and without expanding on those margins there is only so much newsprint that can in fact be collected and recycled.

The discussion often comes up about recycling newsprint into newsprint again via the de-inking operation. More than one of the Canadian paper companies has looked very closely at newsprint de-inking for reuse as newsprint, and at this particular point in time they have suggested that there might be one location in the country, namely Toronto and surrounding areas, that might be of a sufficiently large collection area to support the economies of scale that would enable a newsprint recycling plant to compete with a paper plant. That is under the existing economic structure. You must remember that that existing economic structure has been developed over a long time. It is very much tied to the international markets of pulp and paper and certainly the Canadian pulp and paper industry is the largest industry in the country and you just do not go about making changes in the largest industry without having some significant changes in the economy of the country as a whole.

We believe there are other potential areas. We are looking into wastepaper. We have a reasonably extensive program underway right now in the National Capital area for office waste paper

recovery. Basically the program is divided up into several phases and we are just finishing off the first phase now, and entering into the second phase. This first phase document report will be made available as soon as we can get it printed up, rather than wait for the three phases. But we have identified what the make-up of the office waste papers is and other than the rather strange things we find in office waste, you find that the actual fibres that are in office waste papers are really excellent fibres. The concern, of course, is for the contaminants which run in the grade right back to the lowest grade of tissue or fibre. The results are very promising and we believe that this particular segment or this particular area of commercial waste if you consider office waste as commercial waste is a very attractive one. Basically because what we are looking for and what we are getting at, is a high grade waste paper and this particular waste paper has a market. That is to say it is not like the newsprint or the other low grades of paper fibre that you have to develop a market for. This high grade paper has a market. They can be used in tissue, they could be used in fine paper, they can be used in the back or the top of the underline of a paperboard, they can be used in wrapping papers. So there certainly appears to be a very attractive area and we are hopeful of being able to take the work that we are demonstrating in Ottawa and have it expanded, perhaps initially through Federal facilities and possibly in co-operation with other agencies to other facilities across the country.

I think it is worthwhile to mention of course that marketing appears to be the key to the success of the recycling system. You really should gear your recycling systems to the demand not to the supply. I understand there are some mills in New Brunswick who might have at this particular point rather finite forest resources and I would suggest that if you could get a high grade waste paper from any of your wastes in this particular province you might find a market for them in these particular mills. But I do not think you will find a market for the low grades simply because it is just not there.

I guess basically what I am saying is for the real low grade mixed papers or garbage I am not really holding a lot of hope for resource recovery in the short term.

I suspect rather that in either rural areas, or less populated areas of the country we might better be looking at small heat recovery incinerators or pyrolysis units. I might mention that there is one small heat recovery incinerator that is going to be built, at the Toronto airport. I believe it is to go in later on this year. I think this should prove to be a rather interesting study because everybody in the country pays very dearly, at this particular point, for their energy and if you can set up economically a small heat recovery incinerator this may prove in fact to be a very worthwhile direction.

Another study that we have just initiated is one that is going to look into, for several broad paper product categories, the economic and the other elements or factors that will go into the paper mills' decision to use one form of fibre or another. I say other than economic because economic is in there, but so is risk element, so is assured supply and so are a number of other factors. I think if we can get a handle on what in fact causes a paper company to go the way it does you may have an indication of how you might best intervene in this particular market to bring about greater resource recovery.

You saw in the videotape glass industries receiving cullet and utilizing cullet. There does not appear to be, for a very large percentage of glass recycling, a technological problem. The problems appear to be one simply of economics and I have a table that is a little bit out of date but it proves a rather interesting point. (See Table 2).

TABLE 2 Cost Comparisons for Glass ($/ton)

Cost Component	Virgin Materials	Cullet (Waste Glass)
Raw Materials Delivered	$15.48	0
Cullet Delivered	0	17.77 - 22.77
Fusion Loss	2.95	0
Incremental Handling Costs at Glass Plant	0	.50 - 1.00
Total	$18.43	$18.27 - $23.77

If you look at the cost factors for the virgin materials vs. the secondary materials you see that major elements are, in terms of the virgin materials, the cost of getting the materials to your glass plants, and similarly in the case of the waste cullet, the delivered cullet is of course the principal cost involved. Which suggests that those plants who are having to go very far for their raw materials should find it economic to use cullet.

The situation that we are aware of is in Moncton and perhaps there is someone from Natural Recovery Systems, in Moncton that might want to discuss it later. They have an operation there that is perhaps not unlike the Etobicoke operation. I am not sure which came first, and perhaps it does not matter. But in one of the boroughs of Toronto, in the Etobicoke Borough there is a waste glass collection system that involves a pup trailer being towed around by a compactor truck. The individual householders, and there are 1000 homes in the trial run, soon to be expanded to 3000, have been given individual garbage pails which they put their glass in, having removed the lids, and these are collected. At this particular point they are getting in the order of 2 to 3 tons a week through this collection system, which is brought to a local glass plant. Now at this particular point in time the glass is not separated. The glass plant have hired two people to sort the glass into a color fraction and a non-color fraction. I do not think it takes too much mental arithmetic to figure out that if you have two people working on three tons of glass, that is pretty expensive glass. At this particular point in time according to the glass plants there does not appear to be a reasonable mechanical, optical or whatever system for separating glass into the various fractions.

Some of you are aware of the Franklin, Ohio operation. They are just not getting the efficiency out of that particular operation that they would like to.

I think the video indicated that the glass company in Montreal is paying $15 a ton for color separated material, I think that is probably closer to $20 at this particular point in time for color separated. The Etobicoke operation is getting $10 a ton but that is non-separated. There are a couple of other systems involving glass where there are common bins, if you will, or collection depots within the cities where concerned and interested citizens can deposit their waste glass. Generally speaking the economics of these are not what you would call profit making. They are in fact net costs, assuming of course you do not attempt to take into account the externalities involved.

We are planning to have a look at glass recovery this year. We would like to get a little better handle on some of these figures. These figures were not put together by our Branch, they were put together by a U.S. firm, and I have some difficulty in trying to figure out why raw materials that might come from a very far away location are delivered to some of these glass plants at prices that are almost the same as glass collected within the same city. In any event we hope to have a closer look at the economics of glass recovery.

You may be aware that there are a couple of provinces that have brought in legislation that affect glass containers. Notably I think of the Alberta legislation which is in fact directed towards all beverage containers, glass beverage containers. They have a refund or deposit system much like our beer bottle system through out the rest of the country and at this particular point in time the depots themselves and the crown corporation that is set up to handle the recycled glass, color separates the material and the material is delivered to the Redcliff Glass Plant in Alberta. That is to say some of it is delivered. I guess the total capacity of that particular plant is not sufficient to accommodate all of the glass that is in fact being recycled in Alberta and as a result the remaining glass is unfortunately going into landfill, simply because there is no alternative. I understand the province is working diligently at getting other industries into the province that might be able to use the glass, from glass reflecting companies through to construction materials made out of recycled glass.

There is a fair amount of plastic industrial fabrication waste now being used, that is to say that which is uniform. There are some mixtures now being used to make pallets, fenceposts that type of thing. Generally speaking if you can manage to get your plastic into the thermoplastic category and not have them mixed, you can work with them although inevitably you are developing products that are of much lower quality than that which you originally started off with. I know of no post consumer plastics that are in fact being recycled, I think principally because the heterogeneous mixture that you would get would prevent you from separating it, either manually or any other way into thermoplastics and sub-dividing it into the PVC's, polystyrenes, polyethylenes and the like.

Rubber, is in much the same situation. Bob was just at a seminar this week in Ontario where they looked at rubber. There is, and I've seen the presentation myself, a cryogenic tire fragmentizer that is being developed in the United States, and essentially it by virtue of cryogenics cools the tire to a temperature where it can be fractured into very small rubber pieces discreet from the nylon or the steel or whatever other cording materials are within the tires. At this particular point in time, other than the possibility of pyrolysis with heat recovery I do not know of anybody who has developed a real use for the rubber coming from these.

Tires are a problem in land disposal simply because of the way they react in a land disposal site and the way they come up. It looks as though this is an area that is going to get a little more attention, particularly with the cost of the raw materials for rubber going up. Perhaps pyrolysis is the best route. I just might mention that I have seen an interesting use for old tires, in bank stabilization. I have seen a presentation in the United States that showed them being used in large lagoons that were being used to treat industrial waste. These lagoons were sufficiently large such that they created a fair motion under wind conditions that was in fact eroding the sides of the banks and these tires were placed along the sides of the bank and were used fairly successfully in maintaining the integrity of the bank.

One study we have underway in the National Capital area, again is a demonstration that we hope to expand elsewhere, is the recovery of silver from hypo-solutions in the photographic operations in Ottawa and there are a large number of them. There is a fair amount of silver, certainly to the point where it is economic to go in there, put in the silver recovery units and recover the silver out of them. In addition we have expanded that particular work and we are now looking at the sensitized paper which again has a fairly high silver content, and with the current value of silver it is looking attractive as well. What I mean by attractive, it is going to do more than break even, we are going to be making money on it.

I guess the question that is often directed at the Federal Government is; we have recycling taking place and it is only going to take place to whatever the economics will allow it to take place; what are you doing to get at the basic problem of the overall system giving preference to primary materials vs. secondary materials? One of the areas we hope to look into this year is a review of the available Federal policy instruments that could be used to promote a greater degree of recycling, keeping in mind that it is provincial jurisdiction to handle solid waste and the areas that the Federal Government might get

involved in are those areas that might be best directed towards the Federal Government. Namely fiscal measures, tariff agreements, incentive programs and there are a lot of incentive programs that involve various industries, there are pieces of legislation now in some provinces directed at containers, there is of course Federal legislation in containers as well. And it looks as though there might be some areas where in fact the Federal Government would be better to move than some of the provinces simply because the materials flow across provincial borders.

I would like to mention the Ontario Resource Recovery Program which is now underway. They are currently in the process of building six municipal resource recovery plants. They are building a pilot unit, if you will, or a demonstration unit of two hundred tons a day in North York, north of Toronto, and in this particular plant they hope to demonstrate a lot of the physical, mechanical systems that are involved in municipal mixed garbage separation. In the other five communities they are involving similar frontend plants where they take the mixed municipal refuse, they shred it, then in most cases, it goes through a light - heavy differentiation and they are looking at composting. They are looking at land reclamation. They are looking at a whole series of different backend systems. A lot of these are still in design stages. Some of them have just recently come through the design stage, but I think it is rather significant that the province is putting up, in most of these locations, most of the money involved in the building of the frontend plants. This is I guess a deviation from that particular province's practice in financing solid waste. It was, prior to that, totally in the hands of the municipal officials. Perhaps the stimulation of supply in this fashion will in fact create materials that because of the assured supply of some uniform materials will encourage industries to go in and use that particular material. On the other hand one can argue I guess that it is like putting the cart before the horse if you do not have a market then you put all this secondary materials on the market you are simply going to displace other secondary materials. I guess only time will tell. These plants are as I mentioned now under either design stage or preliminary design stage and they probably will not get operational for at least another few years. That does perhaps give us a little bit of time in order to start developing some of these markets. C'est tout. Do you have any questions? I'll be happy to answer if I can.

TABLE 1

APPROXIMATE STEEL USAGE IN NORTH AMERICA

ITEM			% OF TOTAL	PRODUCT LIFE (YEARS)
TRANSPORTATION	AUTOMOBILE	21.5		
	OTHER	5.5		
	SUBTOTAL	27.0	27.0	10
CONSTRUCTION			26.0	20
INDUSTRIAL	PACKAGING		2.4	1
	MACHINERY + OTHER		23.0	20
DOMESTIC	APPLIANCES		5.0	10
	PACKAGING		5.9	1
	OTHER		10.7	10
			100.0	

FIGURE 1

FERROUS SCRAP POTENTIALLY AVAILABLE IN THE U.S. OVER 5-YEAR PERIODS

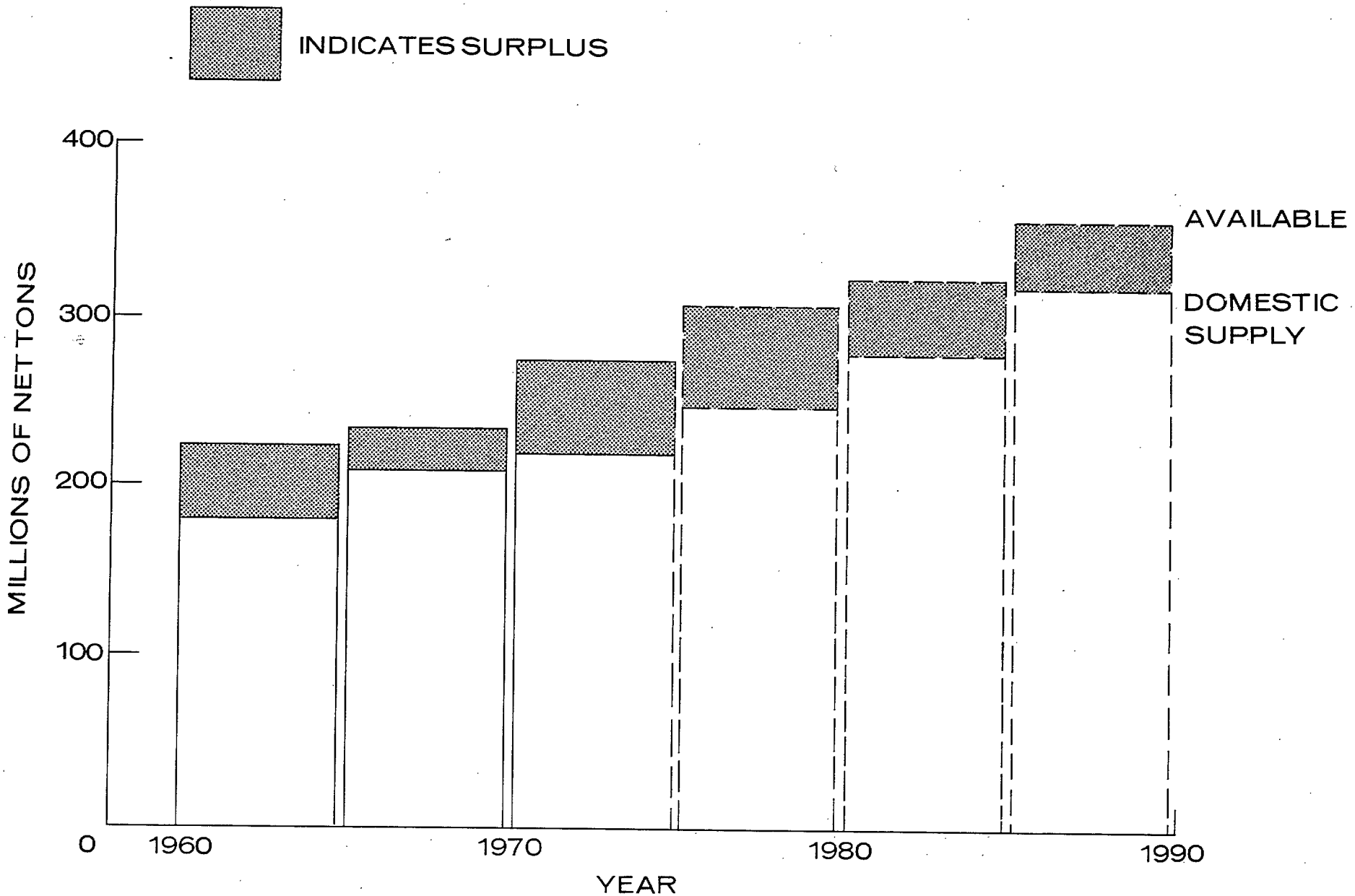
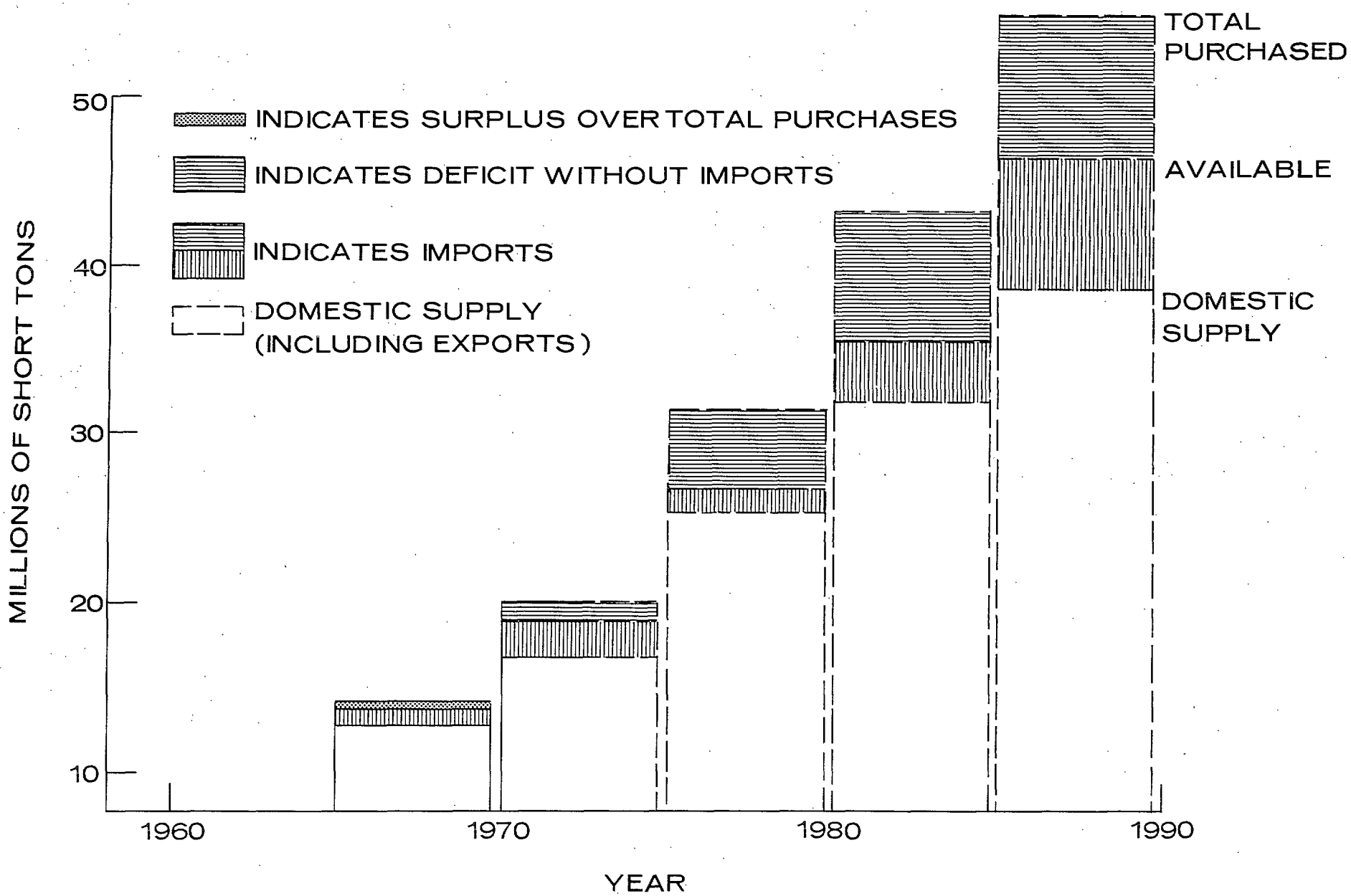


FIGURE 2

POTENTIALLY AVAILABLE PURCHASED FERROUS SCRAP IN CANADA OVER 5-YEAR PERIODS



QUESTION PERIOD: RESOURCE RECOVERY

Question: **(unidentified)** Is there money available for recycling?

Answer: **(Mr. Rattray)** We are very much interested, from a technology development point of view, in, as was mentioned this morning, something that might be different, some area that might prove to be useful on a national basis. Similar to the general solid waste question, which is a provincial jurisdiction, we are not in a position to go into a municipality and finance a resource recovery operation unless it were, in fact, some unique type of operation that would be worthwhile studying and perhaps transferring the knowledge across the country. We hope to be able to make an impact, as I mentioned before, in those areas that I think need an impact. I think that we need to look at some of the basic reasons why secondary materials are not moving and some of those could be institutional in nature, some of them could be historical in nature. There are many different reasons why primary materials in this country are used in preference to secondary materials. Not the least of which is the fact that we have a very large country in terms of geography. You just can not transport materials very far without consuming large amounts of energy. We are all on an energy conservation kick and there are limitations that just prevent you from doing that much.

CHAIRMAN'S REMARKS

Mr. L.P. Fedoruk
Chief, Federal Activities and Solid Waste Division
Environmental Protection Service
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Halifax, Nova Scotia

My name is Lawrence Fedoruk. I am with Environment Canada in the Environmental Protection Service, Atlantic Region in Halifax. I think I would like to review the topics that were discussed yesterday where we started off with the definition of a dump. A dump is a waste disposal site where solid wastes are deposited with little or no regard for pollution control or aesthetics, and from there Bob went on talking about dump closure-site conversion. He started off by asking why should we close a dump. There were 4 possible reasons: legislation, environmental, social and physical. Once it was determined that a dump had to be closed there are four basic steps in the procedure. The first was planning, then education, implementation and maintenance. The first step in any closure program must be to assess the problem and to plan. You notice that planning is always number one and should remain number one. I know that in my work and the work of Ray Benoit planning is number one.

To plan appropriately, you must ensure that the closure procedure proceeds smoothly, the environment is protected, and no harm comes to the people living nearby. Once the assessment and planning stages have been completed it is necessary to educate the general public and this is obvious. If you are going to close the dump you are going to have to go to a new site, people are going to have to know where, or you will just end up with another dump on the closed dump. The next step is to implement the plan. This includes the start up of the new site, a rodent extermination program, grading, compacting, and covering the old site. This is followed by seeding of the site and appropriate vegetation to maintain the integrity of the cover material.

The final requirement of dump closure is to maintain it for a period of time which is likely to be one or two years at least. So, once you have closed the dump that is not the end of it - you have to look after it, if erosion takes place, you have to replace the cover, replace the grass if you put in grass.

Next Bob went into site conversion and whatever disposal method or system that is used to replace the dump or network of dumps, the replacement should be properly planned, properly developed and properly operated. This means that it will probably be more expensive, so therefore it should be economically viable while achieving social acceptance. The choice of the other method will depend upon many factors including population to be served, ability to pay the increased cost, level of service desired, and the other elements of the system. So the site conversion has to take place in stages, a new area has to be established first, and then you go into the rodent extermination program, not forgetting public relations etc. and whatever you convert to, be it a trench method, an area method, bank method or even a more sophisticated form of solid waste disposal, but generally it is felt that if you are converting a site it is usually converted to a sanitary landfill.

The next topic discussed was small sanitary landfill design and there were various topics covered. Hydrology and climatology, soil and geology, volume requirements, site improvements, necessary equipment, water pollution control, control of gas movement.

Good design has little value if it is not properly operated and this goes for whatever you might want to speak of, be it water pollution control, solid waste management. The best design in the world goes right out the window if it is not operated properly. So, the various things in the operation that

should be considered are hours of operation, measuring procedures, traffic flow and unloading procedures, designation of specific disposal areas, and methods of handling and compacting, adverse weather conditions, fire control, litter control, and lastly salvaging if permitted.

Then I believe Bob went into various pieces of equipment that are available, I will not go into that.

The last topic of the day was resource recovery and as the seminar progressed yesterday this topic was brought up several times. As Ted pointed out, on the surface it looks like a great idea. I think we all agree it still is but you have to collect it, you have to transport it, and you have to have the markets for it, and very frequently the economics dictate that it is just not worthwhile to go to the trouble and actually lose money on the effort. That does not mean that we do not keep trying.

That was a brief review. Hopefully at the end of the seminar after what has gone by yesterday and what we discuss today we will have sufficient time that we can answer all questions. That does not preclude you from asking questions at any time when the speakers are finished with their talks. Hopefully we will have a good discussion period right after the end of the seminar. John Payne, our next speaker, received his degree in civil engineering, in England, in 1964. He joined the federal government on the west coast in '66. He worked in the fisheries protection field and since 1972 he has been with the Solid Waste Management Branch in Ottawa with Environment Canada.

REFUSE COLLECTION AND TRANSFER

Mr. J. Payne
Solid Waste Engineer
Solid Waste Management Branch
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1. INTRODUCTION

The methods used to store and collect residential solid waste are essential factors in the maintenance of a community's health and property values. Unsanitary practices lead to the propogation of disease-carrying vectors such as insects and rodents, and casual storage results in a poor aesthetic neighbourhood character and contributes to fire and safety risks. Society has a responsibility, therefore, to ensure that solid waste is properly stored, collected and disposed of.

The public image of the refuse collection service suffers by association with the wastes collected. Many practices are little advanced from those commonly employed at the turn of the century when refuse was collected in horse drawn carts, and collection continues to remain highly labour intensive. The manpower is largely unskilled, working conditions poor and injury rates high (105 injuries per million manhours worked as compared to 53 for police, and 20 for logging, for instance).

The problems associated with refuse collection are not static. General population increase, the trend from rural to urban living and increased per capita waste generation are all increasing the load on community collection systems. In addition, the nature of the waste is changing. Proportions of such items as ash and food wastes are declining and paper and plastics are increasing. This has caused a decrease in overall density and associated handling problems.

Due to the high labour involvement, collection costs represent 75 - 80% of the solid waste management budgets of most communities. Rising labour costs and employment problems are causing a trend to reduced crew sizes and financial pressures in general are forcing more efficient service. Better routing and critical equipment selection can improve manpower utilization and increase efficiency.

Some general statistics on refuse collection in Canada are presented below.

1) Based on a series of recent comprehensive waste management studies the average quantity of residential plus commerical waste generated on a per capita basis in 1974 was 3.26 lb./day (7 days/week basis) in urban areas. This equates to a collection load of 12.4 million tons nationally.
Demolition and construction waste varied from 0.3 lb./cap/day to 0.9 lb./cap/day, and industrial waste collection in urban areas (this excludes such wastes as mining wastes, logging wastes, etc.) from 0.25 lb./cap/day to 3.1 lb./cap/day.

2) From financial data gathered by Statistics Canada the average collection cost for municipal refuse in 1973 was $14.93/ton, and $15.64/ton in 1974.
On a per capita basis, the municipal expenditure in 1974 was $5.01 for Canada as a whole with the following figures for the Atlantic Provinces:

Newfoundland	– $2.83/capita
Prince Edward Island	– $1.36/capita
Nova Scotia	– $3.32/capita
New Brunswick	– $2.87/capita

The differences in unit costs from province to province may be explained by varying degrees of urbanization, levels of municipal service provided and direct provincial expenditures.

2. ON-SITE STORAGE

From the time waste is generated in the home, office or factory it must be stored pending collection for processing or disposal. Objectives which should be achieved by the storage operation are i) the prevention of unsanitary conditions and odours; ii) the prevention of unsightliness; and iii) compatibility with the collection system.

It is generally the responsibility of local governments initially to legislate, then to regulate proper practices for refuse storage and preparation for collection. From a public health standpoint, putrescible refuse must be stored so that disease-carrying vectors cannot have access to it and liquids cannot leak from containers. To prevent the creation of nuisances, wastes of all kinds must be stored so that they cannot be scattered by the wind or animals, disagreeable odours are avoided, and any accumulations are not unsightly. To achieve economical and effective collection, it is essential that suitable containers of proper size be provided and that they are kept or placed where they are easily accessible to the collectors. By-laws governing the storage of waste cover a broad spectrum of level of service and degree of regulation. These two points are dependent upon the wishes of the people affected by the by-law.

A typical municipal by-law is included as Appendix A. You will note that included are requirements with respect to:

- the size, weight and type of containers (e.g. 2 cubic feet, 75 lbs. maximum).
- size, weight and type of bundles and parcels (e.g. 4 ft. X 2 1/2 ft. X 50 lbs. maximum).
- the maximum number of containers, bundles, etc. (e.g. 8).
- the proper placement for pick-up (e.g. as close as possible to the edge of the roadway without causing an obstruction).

- collection schedule (e.g. twice/week).
- prohibited wastes (e.g. liquid waste, earth, brick, stone).

The most commonly used residential refuse container is the galvanized metal can. However, in the past ten years or so, the use of plastic bags has become widespread.

	Advantages	Disadvantages
Galvanized cans	– Strong	– Noisy
	– Long life	– Will rust in time
Plastic bags	– Easier to handle	– Subject to scavenging by animals
	– Save collectors from carrying containers back from the truck	– Add to total refuse
	– Control litter and fly problems well	– Higher homeowner cost

Plastic bags contribute markedly to the efficiency of the collection process. A study performed in 1966 indicated a 12% reduction in time required for collection when cans were replaced by bags.

Due to the shortage of petro-chemical feed stocks, the price of bags has tripled in a short period of time and the trend to plastic bag use has slowed down.

Large capacity refuse containers are often used for high-rise residential and commercial complexes, in addition to their long established use for industrial and demolition wastes. Basically, these containers are metal boxes having a capacity of from 1 to 50 cu. yd. which are emptied by specialized trucks. These containers can be provided by the municipality, the building owner or by the refuse collection contractor and are kept in a service area where the collection truck can have ready access to them for regular servicing.

An effective way of maximizing collection and hauling efficiency is to combine containers with compaction. The stationary compactor unit compresses the refuse by a factor of about 4:1, thus allowing the size of containers required and/or the frequency of pick-up to be reduced. There are two basic types: the horizontal ram and the vertical ram. In the horizontal type, refuse is fed into a hopper and the ram compacts it into a container. The vertical type is a smaller machine in which the ram compacts the refuse into a tight mass in a corrugated carton or plastic bag. As each box or bag is filled, it is moved to the collection area and replaced by a similar empty container. Use of this technology has been increasing during the last decade and is rapidly becoming standard practice.

3. COLLECTION

Types of Service

The level of service desired, offered or provided will determine who is responsible for placing containers at the roadside ready for pick-up. It can be either the householder or the collection crew. In the former case, a level of service referred to as "curb service", the householder must place his refuse at the edge of the roadway in suitable containers by a specified time on collection day. A member of the collection crew empties the refuse into the vehicle and replaces the containers at the curb for the householder to move back to their regular storage location.

In the "backyard" pick-up system, a crew of men travels ahead of the collection vehicle and moves the refuse containers from their storage locations to the curb. After being emptied, the containers

may be left at the curb (set-out service) or put in their original location by the collection crew (set-out and set-back service). As a larger crew is required for backyard service than for curb service, backyard service is more costly (13% difference in the case of Ottawa which employs a private company and a recent U.S. survey has shown that the productivity of backyard systems, in terms of households serviced and tons collected per pick-up hour, is as little as one-half of that for corresponding curb systems). A survey of 48 Canadian municipalities provided the breakdown shown in Figure 1 for the percentages of communities which use backyard service, according to population size.

During the warmer months residential refuse should be collected at least twice per week. This will interrupt the breeding cycles of insects. Some Canadian communities collect twice per week on a year-round basis (30% according to the survey). Because of the large quantities involved, commercial refuse must be collected more frequently, with many places operating daily pick-ups. Bulky refuse is usually collected during special periods once or twice per year.

For residential refuse, approximately 50% more crews and equipment are required for a twice-a-week system as compared to a once-a-week. In terms of productivity, the twice-a-week collection system serves about 50% more homes per collection hour but collects 20% less weight per hour. (U.S. data).

Equipment

The type of refuse collection vehicle usually employed nowadays utilizes the principle of compaction to achieve a higher payload. A typical residential refuse vehicle has a capacity of 16 - 20 cu. yd. and compacts the waste to a density of 500 lb. per cu. yd. Loading can be effected from the back or side of the vehicle depending on the style of body. Crew size is variable but usually consists of a driver and two loaders (about 2/3 of the large Canadian communities use 3-men crews).

Increasing labour costs are encouraging the introduction of systems employing greater mechanization and reduced crew sizes. Various one-man collection systems are in operation. In one type, the driver leaves the cab and empties the refuse into the truck via a side opening from where it is carried back and compacted into the rear. On-route productivity per crew-man in terms of homes serviced and tons per collection hour is largest for this type of system as compared to two, three or four-man crews. One U.S. city has changed from four-man crews to one-man trucks and has reduced manpower from 200 to 33.

Another system uses small satellite vehicles operated by one man. These are used for picking up refuse from individual homes and then carrying it to a centrally located "mother truck" which hauls it to the disposal site. Again, a study in a U.S. city has shown a 22% reduction in cost for the satellite system compared to a conventional three-man crew. However, the potential for this system in Canada would be restricted by the severe winter conditions. Several systems have been designed in which the driver does not even leave his cab, but operates mechanical arms to lift and dump the containers into the truck. These are well developed for commercial collection, but their application to residential refuse collection appears to be limited to the Southern U.S.A. There is no record of them being tested in areas having severe winter conditions.

The following statistics were obtained from the 48 municipality survey. They show that in 1971 for municipal collection (public and contract) an average of one man was employed for every 2,268 persons of the population served, there was one collection vehicle for every 6,504 persons and the average load per vehicle was 39.5 tons/week. Average wages paid were $129/week for loaders (range $82 - $172) and $136/week for drivers (range $92 - $186).

Public or Contract Collection

Should a community's refuse be collected by municipal forces or by private collectors? It would be inappropriate to discuss this question in the context of this paper. This choice must be made in the presence of a detailed assessment of the needs, wishes and capabilities of the municipality receiving the service. An attempt will be made to highlight some of the key points of both services.

Advantages of Municipally Operated Systems:

1) Sanitation and the protection of public health can be the primary aims.
2) There is no profit motive, therefore, in theory at least, the collection service can be less expensive.
3) Better selection and training of workers is possible.
4) Continuous records can be maintained over a long period of time and these are invaluable in the efficient management of collection activities.
5) Operations are more flexible than under the contract method and advantage can be taken of the integration of services and facilities with other municipal departments.
6) Requests and complaints from citizens can be attended to more promptly.

Advantages of Contract Operations:

1) The municipality does not have capital funds tied up in equipment.
2) There may be comparative freedom from extraneous influences on the operation.
3) Contract collection in a particular city may be more economical because of more competent management, better planning of operations and more effective use of labour and equipment, particularly with the recent trend to development of conglomerates in the waste management industry.
4) Costs of collection work are fixed for the duration of the contract.
5) Inefficient employees might be removed more readily than they can be in municipal service.

The survey made in 1971 shows that of the 48 municipalities responding, 75% used public collection to some extent. The breakdown by community size is shown in Figure II.

Separation Collection for Reclamation

With the present depressed market for used newspaper, separate collection is not economically viable. However, conditions will probably change once more and municipalities will again become interested in the subject.

Two basic methods have been developed for source separation collection systems:

(1) the assignment of a separate collection vehicle (compactor truck, closed van, or open-stake truck);
(2) the "piggyback" or rack system whereby racks varying in size from 1/2 to 1 1/2 cubic yards are mounted on the side or back of the compactor truck. The separate truck and its crew travel an independent route solely for collection of the separated materials, typically newsprint or mixed paper. With the rack system paper bundles are picked up on regular residential collection days and placed in the rack, while the refuse mix is loaded into the hopper as normally done.

Each method requires the generator of the wastes to separate and prepare the "source separated material" for the collector. The most appealing aspect of the piggyback system is that mixed

refuse and separated materials can be collected simultaneously by the same crew. However, additional time is expended for handling the separated materials, approximately 14 seconds per stop according to an EPA study. The effectiveness of the piggyback system depends upon the ability of the normal refuse collection system to absorb the additional time requirements, which become more severe with increased participation by the community and greater quantities of separated materials.

In separate collection programs studied to date, only curb or alley service was offered for the source separated materials. Generally the complexities of handling mixed refuse and separated materials and the labor intensiveness of rear door collection rule out source separation for this type of service.

4. TRANSFER OPERATIONS

The hauling of refuse from the last pick-up point on a collection route to the point of disposal is a significant factor in the overall cost of a refuse management system. The concept of transferring refuse from a relatively small payload collection vehicle to equipment designed for bulk haul has been practised for several decades. Reducing the unproductive travel distance of several local collection vehicles by their substitution with one large payload vehicle which travels to the disposal facility can offer savings in some cases. Although a transfer operation can represent potential savings it requires at least one extra materials handling step and the construction of a building. Extra costs will be incurred initially in the capital expenditures for land, structures and equipment, and on a continuing basis for the labour, maintenance, operating and overhead costs for operating the transfer station and the bulk haul part of the system.

Costs savings result from the reduction in non-productive labour time since collectors no longer ride to and from the disposal site, and the reduction in mileage travelled by the collection trucks.

The comparative economics of direct haul versus transfer haul are shown graphically in Figure III. For a given travel time to a disposal site, from a chart such as this, prepared for specific local conditions, the merits of a transfer system compared to a direct haul system can be determined.

There are two basic types of transfer systems. The first is the direct-dump system where a collection truck dumps into a large open-top trailer. The trailer is located under a funnel shaped hopper to prevent spillage and a backhoe may be used to compact lightly and distribute the load. Some type of cable system is usually used to pull the loads out of the rear of the trailer at the disposal site.

The second basic system utilizes hydraulic pressure to achieve compaction of the waste within the trailer, either by use of a bulkhead which traverses the length of the trailer and compacts the waste against the rear doors, or by a separate stationary compactor which pushes the waste into the trailer through the rear doors. The usefulness of this method is usually governed by the maximum highway axle load limits allowed.

A transfer station can be used as a site for an elementary materials reclamation operation. This achieves a dual objective of resource recovery and reduction of the load which must be hauled to the disposal site.

5. OTHER COLLECTION AND TRANSPORTATION MODES

A. Collection

A recently developed method of collection which is applicable to high density residential areas is the pneumatic system in which refuse is pulled through 20'' diameter underground tubes by a vacuum to a central collection point. This method eliminates the need for on-site storage in cans or bags

as the householder simply deposits his refuse into a chute. The refuse falls down the chute to an air-lock at the collection pipe and at regular intervals the lock opens and the refuse is drawn into the system. At the central discharge area it can be processed by incineration or compaction before being taken for final disposal.

B. Transportation

1) Pipeline--There are two basic methods by which solids may be moved over long distances through pipelines--ground up in a slurry, or in capsule form. Both methods have been considered for use as solid waste transportation systems but most of the research so far has been purely theoretical. A recent study by the Research Council of Alberta has indicated that to be viable, such a system would have to handle at least 500 tons/day or entail a haul distance longer than 30 miles, and only in Toronto, Montreal or Vancouver could a pipeline for refuse be justified.

2) Rail Haul-A number of large cities have recently been investigating the possibility of using rail haul as a method of transporting refuse to a distant disposal site. Systems are in operation or are planned in the U.S. and U.K. Metro Toronto has also investigated such a scheme but the project has run into difficulties in obtaining approvals for the distant landfill site. The cost would be $6.10/ton to Metro for rail haul and disposal.

6. SYSTEMS ANALYSIS

The methods of systems analysis can be applied much more readily to the collection of refuse than to its disposal. Various investigations have looked at such areas as:

- design of collection districts
- design of truck routes
- equipment selection
- evaluation of policy options (crew size, frequency of service, overtime policies, etc.)

with a view to increasing efficiencies and decreasing costs. References to some of these studies can be found in the bibliography.

Useful programs have been developed by the Public Technology Institute of Washington and the University of Illinois. The first is a computerized program which divides a community into districts with balanced workloads; enables determination of minimum distance routes; provides a tool to measure the effects of varying the crew size, the vehicle capacity, the workday length, frequency of collection and disposal site location; and provides a quick response to changes in solid waste production and population concentration. The other program consists of a manual method of routing collection trucks within a collection district to minimize the distance travelled, thus achieving savings in time and costs. The application of the latter technique typically results in an 8 to 12% cost saving.

REFERENCES

1. Solid Waste Collection Practice: APWA (1975).

2. A Statistical Estimation of an Operating Cost Function for Municipal Refuse Collection: H.M. Kitchen, Trent University.

3. 11 Residential Pickup Systems Compared for Cost and Productivity: K.A. Shuster, Solid Wastes Management, March, 1975.

4. One-Man Residential Collection Saves 84% in Manpower: G. Frankel, Waste Age, February, 1975.

5. Satellite Collection Vehicles Reduce Cost of Labour: M.C. Stiles, Waste Age, February, 1975.

6. Analyzing Source Separation Methods at Residential Level: J.R. Greco, Solid Wastes Management, October, 1974.

7. Transfer Station Feasibility is Measured Against Direct Haul: J.R. Greco, Solid Wastes Management, April, 1974.

APPENDIX A

BY-LAW NUMBER 1960-58

A By-law to regulate the handling, collecting and disposal of Garbage, Ashes and other refuse in the City of Peterborough and at disposal sites operated by the City of Peterborough outside the limits thereof.

Passed the 16th Day of May, 1960

WHEREAS the Corporation of the City of Peterborough collects and disposes of certain garbage, ashes and other refuse from within the City of Peterborough.

AND WHEREAS the City has entered into and may from time to time enter into agreements under provision of section 388, sub-section 1 (85) of The Municipal Act of the Province of Ontario, with municipalities adjoining the city for the disposal of garbage, ashes, and other refuse on lands in the adjoining municipalities, whether owned by the City of Peterborough or not.

NOW THEREFORE THE CORPORATION OF THE CITY OF PETERBOROUGH BY THE COUNCIL THEREOF ENACTS AS FOLLOWS:-

DEFINITIONS

1. That for the purpose of this by-law, the following words shall have the meaning given herein:-

   (a) "Garbage" shall mean all rejected, abandoned or discarded household waste, either animal or vegetable, wearing apparel, sweepings, grass, weeds, branches of trees (if properly prepared as set out below), waste paper, and other refuse matter but shall NOT include disused furniture, metal, stoves, building materials, broken glass, swill or other liquid waste, ashes, manure or night soil, hot material capable of starting fires, industrial waste, wholesale, retail or commercial trade waste, garbage or service station wastes, material frozen to receptacles which cannot be removed by shaking. In the case of any hotel, restaurant or apartment house or other premises providing restaurant service, requiring more than two collections of garbage per week, "garbage" shall mean table and kitchen waste consisting of animal and vegetable matter only, with which no other waste product or material shall be mixed.

   (b) "Ashes" shall mean any residue of any fuel for heating or cooking purposes and soot or other cleanings from chimneys and tins (other than food tins), bottles, crockery and glass, weeds and brush.

   (c) "Householder" shall mean any owner, occupant, lessee, tenant or any person in charge of any dwelling, hotel, restaurant, apartment house, office building, public institution or other building.

   (d) "Dwelling" shall mean any building or place of abode other than a hotel, restaurant, apartment house, tenement or building which accommodates more than two separate dwelling units and shall include schools, charitable institutions, public hospitals and public libraries, as well as residences.

   (e) "Street" shall mean any public road, street, lane, alley, square, place, thoroughfare, or way within the City of Peterborough.

   (f) "Supervisor" shall mean the City Engineer, Sanitation Superintendent, or any other person from time to time named by the Council of the City of Peterborough to control collection and disposal of garbage, ashes and refuse.

SUPERVISION

2. The proper collection, removal and disposal of garbage, ashes and other refuse shall be placed under the control of a Supervisor of Collections who shall be responsible to the Council of the City of Peterborough either directly or through one of its regular standing committees, as directed by Council.

COLLECTION PROCEDURE

3. (a) Collections shall be made from all premises according to the following schedule:

   (1) From all residences, rooms, offices, stores and other premises not otherwise provided for, two times each week.

   (2) From all stores and shops within the fire limits, two times each week.

   (3) From all hotels, restaurants, and other food dispensing establishments as may be deemed necessary by the Medical Officer of Health, two times a week, except in the case of established businesses where nine (9) acceptable containers are not sufficient to contain the normal garbage ready for collection, in which case a third collection weekly will be provided.

(b) Collection from any dwelling shall consist of a total of not more than four receptacles or bundles (8 cubic feet) per collection which meet the requirements of Section 4 of this by-law.

Collection from any premises other than dwellings shall consist of a total of not more than nine (9) receptacles or bundles (18 cubic feet) per call, which meet the requirements of Section 4 of this by-law. Notwithstanding the foregoing collection from premises including dwellings may be made above the limited number of receptacles or bundles stated provided that to each receptacle or bundle set out on the regular collection day above the limited number there is attached a tag or ticket, which shall be purchased at the office of the City Clerk and shall cost twenty (20) cents. Such tag or ticket shall be deemed to be the required payment for the removal of the contents of the extra receptacle or bundle, as described above, over the limited number stated and each additional container shall have such tag or ticket attached to it before the contents will be removed by the Collector; this provision to be strictly enforced.

(c) Material for collection shall not be placed on a highway or other public property before 6:00 p.m. on the day preceding collection and shall be placed at the prescribed location for collection not later than 7:00 a.m. on the collection day.

(d) Empty receptacles as well as all material which the collector refuses must be removed from the highway or from public property by the occupant of the premises from which they came, before 8:00 p.m. on the same day that the garbage is collected or the material refused.

HOUSEHOLDERS' RESPONSIBILITIES

4. (a) No person shall permit garbage, ashes or other refuse including paper of any description, to be blown or dropped from the premises occupied by him or from a vehicle owned or operated by him onto any lane, street, creek, roadway or other public property in the City of Peterborough.

(b) No person shall sweep, throw, drop or place, or cause to be swept, thrown, dropped or placed, any garbage, ashes, offal, paper, dirt, lawn rakings, glasswear, cans, animal carcasses or refuse of any kind whatsoever on any lane, street, creek, roadway or other public property in the City of Peterborough except for and in the manner approved for collection as hereinafter provided.

(c) All garbage, ashes or other refuse to be collected by the City of Peterborough must be placed and kept in receptacles or containers in accordance with the regulations herein.

(d) Every householder shall provide sufficient proper receptacles of not more than two (2) cubic feet capacity which, with contents, weigh not more than seventy-five (75) pounds and are satisfactory to the Supervisor for the deposit of garbage and ashes. Receptacles shall have suitable handles, shall be kept dry and regularly disinfected. Receptacles which are smaller at the top than at the bottom shall not be used for the deposit of garbage and all receptacles therefor shall be circular in construction and of galvanized iron or other suitable material approved by the Supervisor. Every householder shall maintain the said receptacles in proper order and repair for the dwelling occupied by him.

(e) Every householder shall thoroughly drain and securely wrap in paper all garbage, before placing it in receptacles or containers. No liquid materials shall be placed in receptacles or containers and receptacles or containers having such materials mixed with garbage or ashes shall not be emptied by the collector. This section shall not be deemed to apply, nor shall it apply to hotels, restaurants, boarding houses or to any other place where this provision would so increase the quantity of garbage that the number of receptacles or containers required would be such as to entitle the householder to more than two collections per week.

(f) No receptacles shall be filled above the top level and all receptacles shall be provided with good water-tight covers which shall be properly placed and maintained on such receptacles at all times, so as to preclude ingress or egress of flies or the escape of odours therefrom.

(g) On the days of collection all such receptacles shall be placed as close as possible to the edge of the roadway without obstructing the roadway, sidewalk or footpath, and shall be placed in a position easily accessible to the collector and approved by the Supervisor.

(h) Such refuse as crates, newspapers, packing materials, brush, bedding, and material of like nature may be collected in like manner as garbage and ashes if securely tied into compact bundles or parcels not exceeding three (3) feet in length and two (2) feet in any other dimension or weighing over fifty (50) pounds, or placed in sufficient receptacles as specified herein so that they will not be scattered.

(i) No house holder shall allow garbage, ashes, or other refuse to accumulate upon any premises nor keep a garbage dump or receptacle or repository for waste material on his premises in such condition or in such a location that the same is a nuisance or emits foul or offensive odours or harbours or attracts rats or other vermin or insects and the body of any dead animal must be promptly disposed of by the owner thereof, so that the same shall not become a nuisance.

(j) Applications shall be made to the Supervisor by persons to place ashes on their premises for filling and raising the level of the land.

COLLECTORS' RESPONSIBILITIES

5. (a) The men employed as collectors shall follow such routes as shall be laid out by the Supervisor and conform to all instructions from him. The work of each route shall be completed daily and the collectors shall be courteous and render every reasonable facility to the householders for the proper execution of the work.

(b) The collector shall handle all receptacles with due care and after thoroughly removing their contents shall place them where taken from. He shall not overload any truck or allow any of the contents to fall on the street and shall carefully gather up any refuse which may have spilled on the ground.

(c) In no instance shall the collector be called upon to make collections from any point which, in the opinion of the Supervisor, is unreasonably inconvenient or dangerous to any employee nor shall the collector be required to remove receptacles from any point other than that designated by the Supervisor, and then only from receptacles or bundles in accordance with the requirements of Section 4 of this by-law.

(d) No salvaging of any description shall be conducted either on the collection routes or in and around the disposal area unless by the express consent and agreement of the Council of the City of Peterborough.

(e) Except by order of the Supervisor no garbage collection vehicle owned or rented by the City of Peterborough shall enter a privately owned roadway or land or other private property for the purpose of garbage collection and except with such order collection shall be made from the public highways.

(f) No city collector shall be required except by order of the Supervisor, to enter any house, apartment house or other building or ascend or descend any stiarway or enter any elevator, hoist or loading platform for the purpose of garbage collection.

ADMINISTRATION

6. The Supervisor is hereby authorized and required to do all things which he is required or empowered to do under the provisions of this by-law or any other by-law of the Corporation relating thereto.

In the event of it appearing during the administration of the provisions of this by-law that there is any matter or thing requiring to be dealt with as to which no provision has been made or as to which the terms of this by-law are not clear, or which is in dispute, the Supervisor is hereby authorized to take such steps as are in his judgement advisable and to report the matter at the first opportunity to the standing committee of City Council thereby concerned.

SCOPE, DEFRAYMENT OF EXPENSE

7. (a) The expense of the collection, removal and disposal of garbage, ashes and refuse from the City of Peterborough shall be borne by the owners or occupants of the land in the said municipality and a special rate shall be imposed on the land in the said municipality according to its total assessed value, sufficient to defray the expense of such collection, removal and disposal and no land in the said municipality shall be exempt from the said special rate, anything in any general or special Act or in any by-law to the contrary notwithstanding.

(b) The special rate to be imposed for the collection, removal and disposal of garbage, ashes and other refuse in the City of Peterborough shall be for one year from the first day of January until the thirty-first day of December in the same year, both days inclusive, and each year thereafter, and shall be sufficient to pay the costs of such collection, removal and disposal for the year.

(c) The special rate provided for in Sections 7 (a) and 7 (b) hereof shall be placed upon the Roll of the Tax Collector during the year in which the same is to be collected and shall be collected in like manner and at the same time as all other Municipal Taxes.

USE OF DUMPS OR DISPOSAL AREAS

8. (a) No person shall bring any garbage, ashes, or other refuse to any lands and premises, whether owned by the City of Peterborough or not, in any municipality adjoining the said City, wherein the City of Peterborough has, by agreement entered into with the said adjoining municipality under provisions of Section 388, subsection 1 (85) of the Municipal Act for disposal of garbage, ashes and refuse from the said City thereon, and being generally known as the City Dump or Disposal Area and place or dispose of any garbage or other refuse upon such lands unless the said garbage or other refuse has been collected within the territorial limits of the City of Peterborough.

(b) The provisions of the above Sections 8 (a) of this by-law shall not apply to garbage and other refuse collected by the authorized collector(s) of any of the said adjoining municipalities with which the said City may enter or may have entered into agreement expressly providing for disposal of garbage or refuse by authorized collecting agents of the said municipality upon the said City Dump or Disposal Area.

(c) Any vehicle traversing the City Dump or Disposal Area shall do so under the direction of the Supervisor or any Assistant appointed by him to be in charge of the said Area and may be directed or dispersed by him in such manner and to such place or position as he may deem fit, in order that the intent and purpose of this by-law may be carried out and the said Supervisor or Assistant may at any time refuse to any person dumping or disposal privileges upon the said Area if his directions and instructions are not carried out in a satisfactory manner by such person. Such vehicles using the said Dump or Disposal area(s) shall do so at their own risk and shall save the City harmless from any damages or claims which may arise from their use of the said Area(s).

The decision of the Supervisor or his Assistant shall be final.

TRANSPORTATION OF REFUSE

9. Any person or persons carrying or taking garbage, ashes or other refuse to the City Dump or Disposal Area in an uncovered vehicle of any kind shall at all times have and keep the said garbage, ashes or other refuse covered by a tarpaulin, canvas covering or other suitable covering, within a vehicle whose sides extend higher than the contents therein, in such a manner as to prevent the said garbage, ashes or other refuse falling upon the streets or highways leading thereto.

The above provision shall apply when garbage, ashes or other refuse is being transported upon any highway, so defined by The Highway Traffic Act, within the City of Peterborough, and upon any other such highway leading to the City Dump or Disposal Area provided, however, that such regulation is not contrary to any regulation imposed by any other municipality or authority having jurisdiction over such other highway.

PENALTY

10. Any person guilty of a violation of this by-law shall on conviction thereof be liable to a fine not exceeding Three Hundred Dollars ($300.00) and costs for each offence and in default of payment thereof the said fine and costs may be levied by distress and sale of the goods of the offender and in case of there being no distress or not sufficient distress out of which the same can be levied, the said offender may be committed to the common gaol of the County of Peterborough for any period not exceeding six (6) months unless the fine inflicted and costs (if any) including the costs of the distress and of the committal and conveyance of the offender to the said gaol are sooner paid.

EXISTING BY-LAWS REPEALED

11. By-laws Number 4493, 5077, 5105 and 1957-121 of the said Corporation are hereby repealed.

DATE OF EFFECT

12. This by-law shall come into full force and effect on June 1st, 1960.

(Sgd) DONALD A. LOUCKS,
(Mayor).

(Sgd) E.A. OUTRAM,
(Clerk).

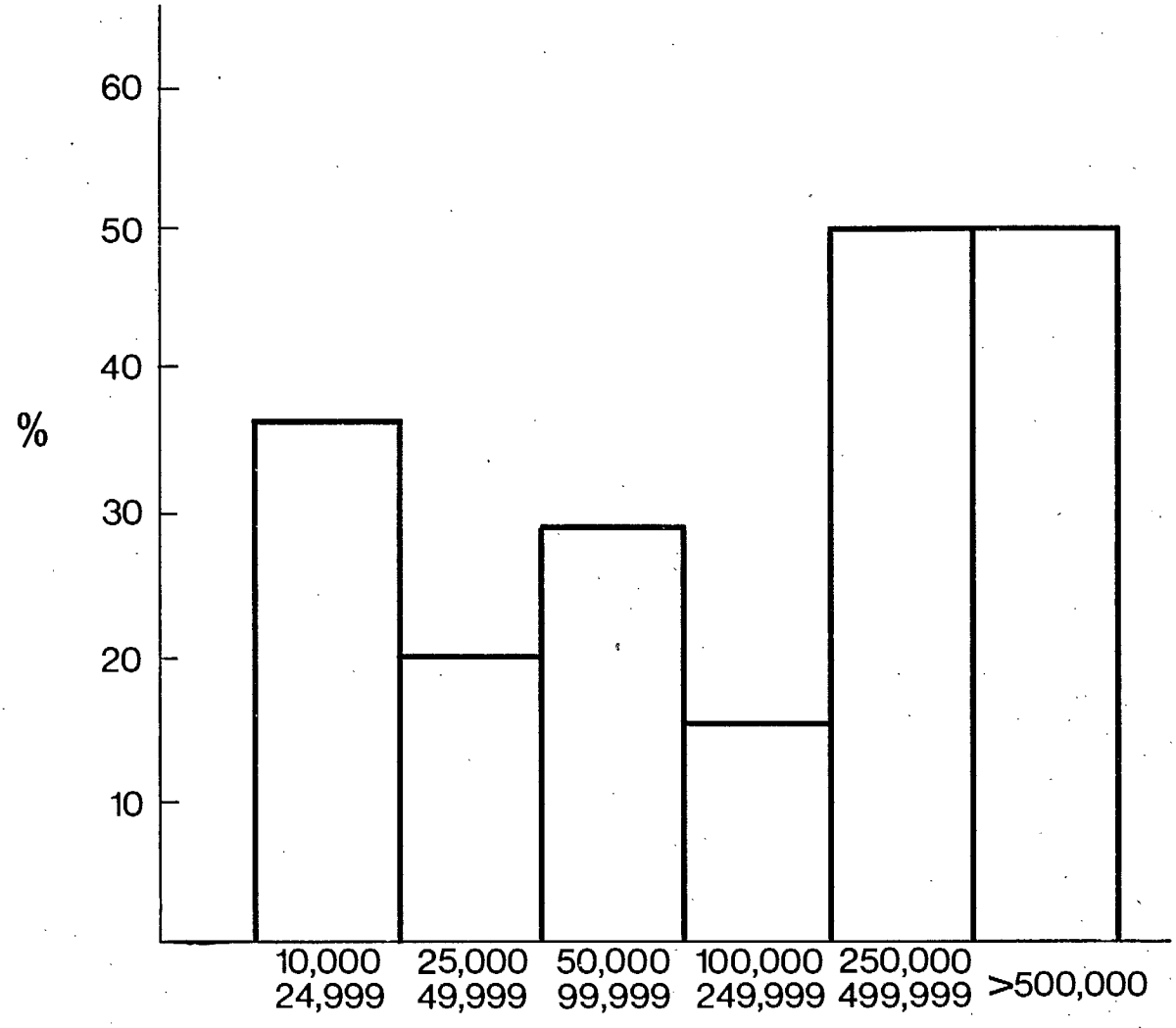


Figure I % of Communities with Backyard Service

(1971 data from 48 municipalities)

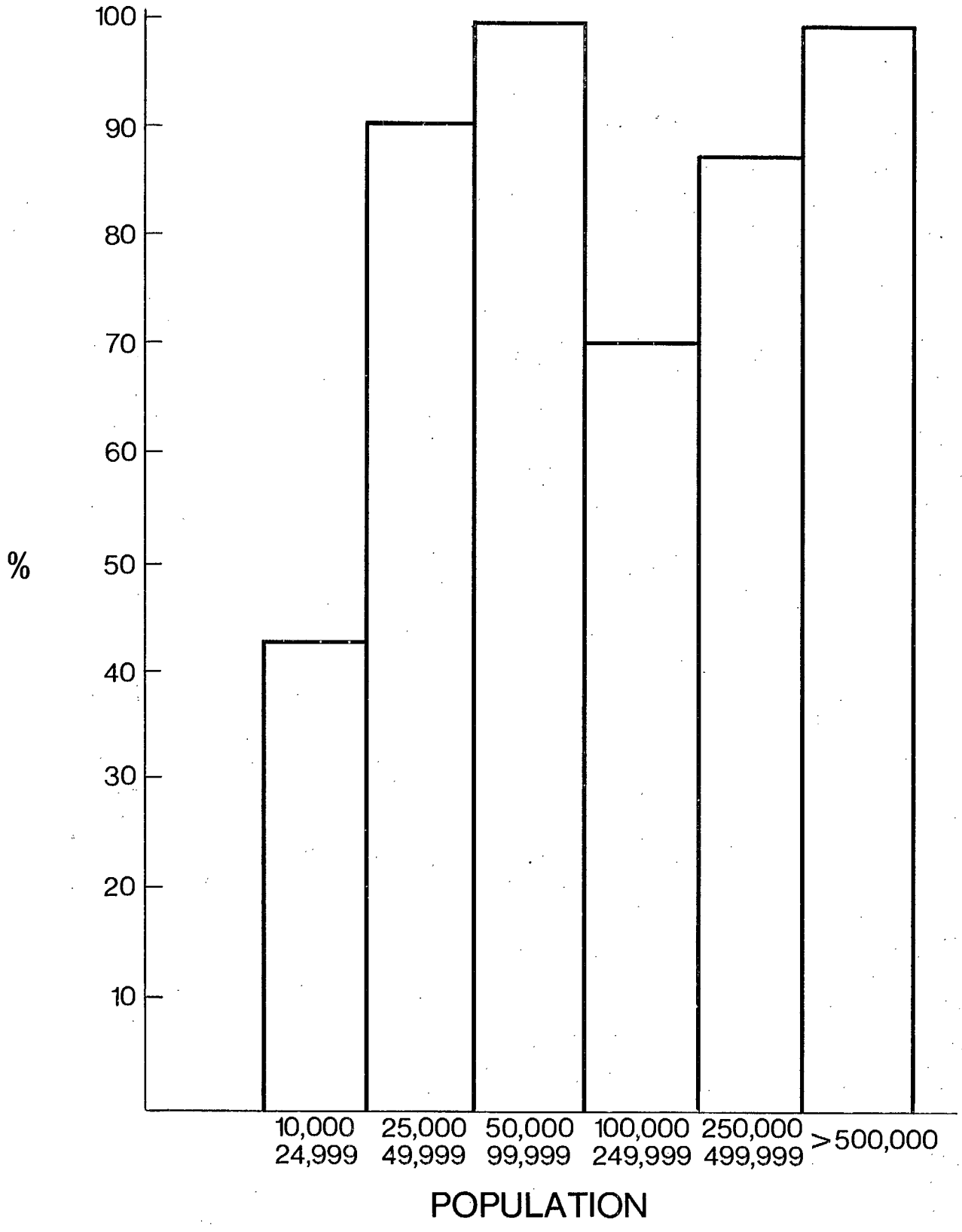
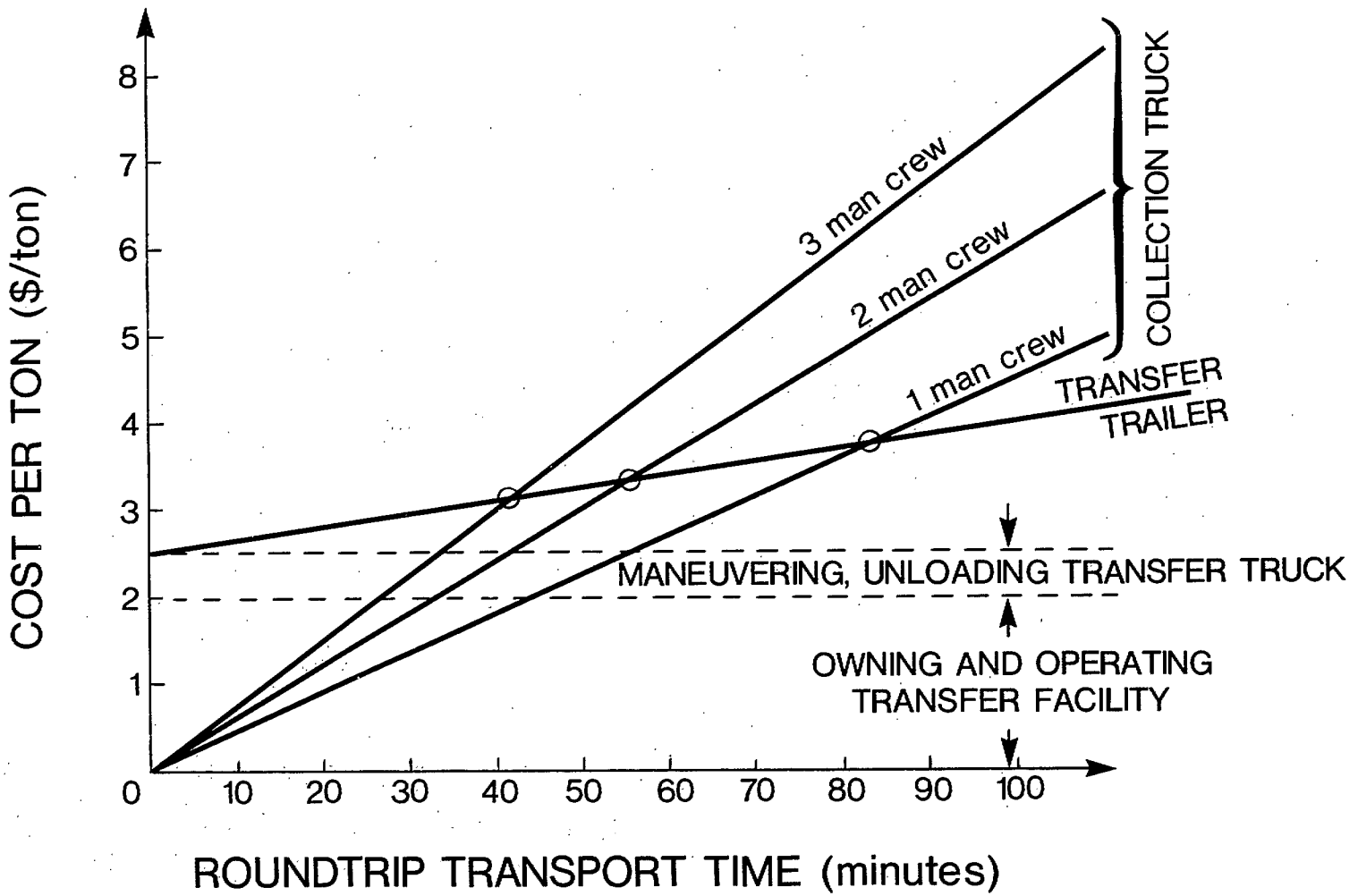


Figure II % of Communities with Public Collection Service (1971 data from 48 municipalities)

Figure III Collection Vehicle Direct Haul and Transfer Trailer Comparison



QUESTION PERIOD: REFUSE COLLECTION AND TRANSFER

Question: **(unidentified)** In most of the pictures we have seen, either slides or videotapes it seems that at least 70% of the garbage or refuse is reclaimable, be it paper or possibly glass. Even at the present time when there is no sale for cardboard, I am wondering whether it is possible for the savings of taking the paper out, baling it and stock piling it for future sale would out weigh the carting of all of this out to a sanitary landfill?

Answer: **(Mr. Payne)** I would say that the problems of storing it -- Ottawa tried this for several months last fall when they could no longer sell the newsprint. They had a great warehouse and over the course of two months, in order not to turn people off who had been used to seperating their papers, to keep them in the spirit they said, "OK we will still collect it, and we will store it ourselves". But after a couple months they got a warehouse full, there was a great fire risk and the fire department was after them. They had scoured the world from Japan to Europe to find somebody to buy it. They could not give it away. They realized that they just could not keep storing the amounts anymore, so they had to switch it off. Unless there is a very localized market that gives you very specific conditions here somewhere, it is not worth it at the moment, or unless you can get source separation of the good stuff. Ted maybe could say more on this. But again this office waste -- if you can get people to separate carbon papers, paperclips, and newpapers from the other stuff which is high grade, there is a market for it. But most of the stuff that is in the municipal stream I do not think so. I agree with Ted, I think, for awhile at least if we can get to energy recovery that is the way to go.

Comment: **(Mr. Rattray)** The amount of time you can afford to store the material obviously is a function of the material, and the people who are right now in the secondary materials industry who are storing their materials suggest that you can store for only for a matter of, at the lowest grade of materials, a couple of weeks to a month and the highest grade of materials only in the order of many months. Even then your storage costs start to eat too much into your profits to be able to do it. So, there is just not that much time that you can in fact carry over periods like we are into now where the economy is such that the materials are not flowing.

Comment: **(unidentified)** This seems strange because we have been storing since November baled cardboard, and all through the winter, and last week we transported a trailer load to a mill and the increase in weight was less than 1%. That is storing it outdoors all winter.

Question: **(Mr. Rattray)** This was not protected?

Answer: **(unidentified)** Not protected except the cardboard on the top was on the rotten side. It was a very small operation granted, but most of us in this area are talking small.

Comment: **(Mr. Rattray)** I do not know about storing it outside other than in Ottawa's case where they covered it with polyethylene. I am talking about storing it in actual warehouses in urban areas where you have to pay for the warehousing. The secondary materials people tell me that it just is not worthwhile under those conditions. Outside perhaps, is a different condition.

Question: **(unidentified)** Mr. Payne, earlier in your paper you gave a cost of a little over $15.50 per ton for collection. Is that for once or twice weekly collection?

Answer: **(Mr. Payne)** That is a national average, by taking annual municipal expenditures from communities which have once per week, twice per week, the whole thing. I have just taken the gross figures for expenditure and my calculations for municipal generation, dividing one into the other. So, it is an average of the whole thing.

Question: **(unidentified)** If you could separate the two, though, would you see that same 50% difference between them?

Comment: **(Mr. Payne)** What did I say there about the twice per week collection?

Answer: **(unidentified)** You refer to 50% more men and equipment required for twice weekly collection.

Comment: **(Mr. Payne)** Yes, 1 1/2 times so that would give you 1 1/2. To get it on a per ton basis the more frequent your pick up the higher your generation of refuse. If you only pick it up once a week people find other things to do with it. They will burn a little bit more or leave a little bit more somewhere else but if you pick it up more frequently it seems to increase the generation rates, so you have to take that into account plus your increased costs.

Question: **(unidentified)** How do you break that $15.50 per ton down? Are you talking about any type of truck? Or are you talking about compaction units?

Answer: **(Mr. Payne)** No, again it would include everything from the largest municipalities to the smallest one, places with large compaction units, places with transfer stations down to the smallest recorded municipal expenditures. It is just a broad average that gives us some idea of what is spent nationally in Canada.

Question: **(unidentified)** There seems to be a discrepancy in weight per cubic yard it increases, you mentioned 500 lbs. per cubic yd?

Answer: **(Mr. Payne)** In a compactor truck.

Question: **(unidentified)** Well in one of the pamphlets from yesterday, it was more like 1200 lb./cu. yard.

Answer: **(Mr. Payne)** That is the highest density you will get in a landfill. Once it has been run over many times by a D9 or something. In a truck I do not think so. 1600 lb./cu. yd. you can get with a baling machine at a baling landfill with free access compression you can get 1600. The highest you usually get in a landfill, a very well operated landfill, in the ground is 1200. It usually runs more like 1000 and in a compactor truck it is more like 500. Loose it would be 150-200 lb. per cu. yd.

Question: **(unidentified)** What is the average tonnage a municipal collection will pick up in a day?

Answer: **(Mr. Payne)** The average was 40 per week, 5 days would be 8, 8 tons a day on an average. The best systems will pick up from about 600 residential units in one day - an average would be more like 300, perhaps 400. You can work that out at 4 people to a household and 3 1/4 pounds per day you can get a maximum, but the average is 8 tons per day.

Question: **(unidentified)** Do you have any statistics on policies? This is not directly related to collection, it is more disposal. The policies of cities who charge for industrial disposal

of waste. I noticed in the videotape it was a pay system, where industrial users pay. Do you have any statistics?

Answer: **(Mr. Payne)** No, I have no exact statistics. The usual case is that municipal trucks and trucks under contract with the municipality will dispose free. Other commercial and industrial vehicles are charged a rate which depends on the monopoly that the facility has in the area. Some places are low at $2.00 a truck load, which can be 5 tons, other places would charge by a ton if they have a monopoly on the disposal facility and they know that to get to another facility that the guy would have to drive 30, 40 or 50 miles. Some places charge $5.00 a ton so that for a regular compactor load they can be paying up to $25.00. This will all be reflected back in what they charge their industrial customers. But, I have no exact figures, to tie that down for you.

Question: **(unidentified)** What do you think about that happening, say, in the Maritime provinces where landfill is readily available and just about anybody can buy land and easily operate their own industrial landfill. Some firms do that. That does not happen in the Maritimes, at least I do not think it does. I was just wondering what your opinion is?

Answer: **(Mr. Payne)** I think it is primarily up to the provincial governments to regulate very strongly these landfill sites to start with so that not just anybody can open up anything that he likes and run an open dump. So this immediately deters people and if they know that they have to first of all put out a capital expenditure of, say, $25,000 for clearing the area, fencing it, putting in the litter fences, putting in the services, this kind of thing. But, if you have got the situation where a guy can just drive across the street and drop it for a small fee, you will never get anywhere. So it depends very much on the provincial, in this case, regulation.

Question: **(unidentified)** Is there anything being done on education in regard to say, table garbage or household garbage -- composting it in your own backyard?

Answer: **(Mr. Payne)** Not as a concerted effort by ourselves. There are various groups that advocate this that have, I am sure, literature on it. But I am not aware of any government agency pushing it, maybe the Department of Agriculture has got some information on it.

Question: **(unidentified)** It just seems to me that if every household cut down by 5 pounds per week of household waste, in other words your potato peelings, tea bags and put them underneath your rose bushes. You could cut down a considerable amount of waste, which could improve your pick-up just within your city or your town.

Answer: **(Mr. Payne)** I agree in principle it is good. It should be part of our future plans when we are looking at source reduction, that would obviously be one of the things that we will have to get into somehow or other.

Comment: **(unidentified)** I do not think it should be one of your future plans, it should be one of your immediate plans. I do not see how you can tie it into the Department of Agriculture, when you are talking Environment. I think agriculture is the same as any other source of pollution. It is an environmental issue, an issue that you fellows should be dealing with right now.

Comment: **(Mr. Payne)** Federally, they do take a great interest in farm waste. They are quite active in looking at reuse possibilities for organic wastes for farms.

Comment: **(unidentified)** We are not talking organic wastes we are talking about household waste here. Damn lack of education.

Comment: **(Mr. Rattray)** There is a problem, of course, in the wintertime in this particular country. We have a lot of snow and this makes composting rather difficult, but your point is well taken. If we were going to go to municipal recovery systems perhaps there is merit in having our food waste separated. Whether or not the municipal people who are responsible for health and all the rest of it would like to have food wastes - perhaps in some households it would be well operated, perhaps in other households it would not be very well operated. You could get into perhaps vector problems, you could get into health implications and I guess there is a number of factors to it, and obviously like any system you have some people who will abuse it and some, you know.... I might mention that in some European ....

Question: **(unidentified)** Which is worse then, having organic material to, freshen up your lawns etc. etc. or start to introduce chemicals?

Answer: **(Mr. Rattray)** I am not disagreeing with you. Personally I do it myself and I do it through the summer but I find it most difficult to do it through the wintertime, and I do not do it in the wintertime. I might mention that things are moving in that way. In Europe and in some European communities there is a fair effort taking place by private firms who will collect food wastes, not from households because they find it too much of a problem, but from restaurants and commercial operations. They take these food wastes and they reconstitute them into animal feed. Of course you have the situation - I was just talking with Lawrence yesterday about the situation you have in the Maritimes where you have a fair amount of potato peelings, you have a fair amount of fish offal waste, you have a fair amount of what we would consider to be valuable protein or valuable food waste and yet we can not, in the affluence that we have in North America, we can not take those wastes in the quantities that we have them, convert them back into animal feed and compete with soybean. We are in ....

Question: **(unidentified)** Are we giving as much subsidy to those recycling processes as we are to the soybean production?

Answer: **(Mr. Rattray)** No, I agree with you. I do not think we are supporting, through our Industry Trade and Commerce or through our Department of the Environment or through any other direct or indirect subsidy program. I do not think we are sponsoring those programs nearly to the extent that we are the other programs that we have traditionally thought to be the way to go, namely primary resources. I think things are changing and I think they will continue to shift in the direction of the conservation philosophy, because it is certainly coming home. Maybe artifically coming home because of the oil shortage and all of a sudden the concern for resources, both renewable and non-renewable. The very fact is that conservation is a philosophy that is now getting into programs and the very fact that we are in existence and the very fact that we have a resource recovery program is just part of this new change. It is going to take time, that is all.

Comment: **(unidentified)** I will make one further suggestion. The province of New Brunswick is now cut to the 100% maximum cut of our forest industry, and if our budworm keeps on, well we could be a little bit shaky again there, and I see yesterday you were talking about removal of print and one thing or another. Now we use an awful lot of wood in the construction of homes in the province of New Brunswick. I think the

government, both levels of government, all levels of government, could very well initiate a study into the recycling of paper into building products. The insulation power is wonderful, you sure as hell do not have to take the ink out of it, because you put tar back in, so you do not have to worry about colour. You can use the cheapest grade there ....

Comment: **(Mr. Rattray)** The second largest utilization of wastepaper in this country is in construction papers and boards. There is no doubt about it. It can use the lowest grades whether it be roofing felt or whether it be fibreboard. Again in these markets you are competing against the chips from the primary operations and presumably the industries who are in a position to make the decision, now do so for a number of reasons which I mentioned yesterday. Of course they presumably follow the one that they find most economical for them. But, what we have to devise is a system that tries to internalize some of these other costs that are not showing up now and change the economics such that it is favourable to take these secondary materials.

Comment: **(unidentified)** You are not competing with chips today. As far as I am concerned, there is not competition. Chips are needed in the pulp and paper industry.

Comment: **(Mr. Rattray)** If you are talking about putting it into construction board, assuming your market is not down like it is now, it is a viable alternative. Technologically many of the things you have suggested today and many of the things that were suggested yesterday are not a problem. It is a matter of transferring or changing or shifting economics to make them more favourable. I think it will come.

Question: **(unidentified)** What you are saying in other words, is that we should buy from Ontario from the existing mills that are manufacturing building products rather than manufacturing products down here?

Answer: **(Mr. Rattray)** No, as a matter of fact there is a fair concern that I have over recycling. As you are aware, most of the manufacturing industries that utilize the recycled materials now are located close to the population centres that generate them. As a result I think it is fair to say that a fair amount of our recycling industries, at least for the next 5 to 10 years, are going to be located close to those large population centres. In fact, that which is used now is located next to those large population centres. If we push very strongly in a hurry resource recovery which is, from an environmental point of view, acceptable, and certainly in our interest to do, I think we are going to find that there is going to be a natural shift of recycling to these centres again. We have a federal department in the form of DREE which spends a tremendous amount of money each year transferring jobs from urban to rural areas, and we do not want to by the stroke of a pen, have a philosophy that transfers them the other way. There are conflicts. It is a matter of priorities. It is a matter of deciding when you shift from one operation to another what those ramifications are, and they are not necessarily technological only. They are not economic only. There are many, many different implications to urban - rural labour shifts and such things that are important to the country. Certainly the federal government is spending dollars over here transferring some of these things. It has to be aware that another arm of the government is doing something that is just working in opposition. These things have to be taken into account. Not the least of which is the international problem. We deal very much in most of our resources in an international marketplace, and when you start shifting things in the international marketplace you can only control that which is on your side of the border. That also becomes a problem something that has to be looked at.

Comment: **(unidentified)** I will agree with you.

Comment: **(Mr. Rattray)** It sounds easy but it is a very complicated issue.

Question: **(unidentified)** One other question that I would like to ask is in regard to newsprint. Four months ago there was a news release about a person in Maine who came up with the idea of manufacturing insulation from newsprint. That night I went to the New Brunswick Development Corporation and asked whether they would find out anything about it. To date I have not heard anything on it. I was just wondering whether Environment knows anything. He claims it is rodent proof, fire-proof and it is easy to manufacture from newsprint.

Answer: **(Mr. Rattray)** I do not know of that specific operation. I have not heard from anybody in New Brunswick on it, but about a year and a half ago I was exposed to a similar development on the west coast of Canada where they were taking the waste fibres and they were making a construction board out of it, that could be used in building homes or any other operation. At that particular time in order to make it fire resistant they had to add certain resins and they also had to have of course the resins in order to build the paper, or build the board. They put together unit costs of that particular operation and we looked at them and it looked to be attractive at that time. In a period of about 6 months you had such a tremendous change in the cost of resins. All of a sudden that particular operation no longer looked attractive. Furthermore, they were still having some difficulties getting through the underwriters the fire resistance of these particular materials. I have not heard back from them. I think on the basis of the changing economics it was just dropped by this particular firm on the west coast. We did direct them through to Industry, Trade and Commerce who, as you are aware, are in a position to grant funds to developments of this particular type. It is not within Environment's mandate although we can certainly recommend to them that this is a good idea, it utilizes solid waste that would otherwise be going to land disposal, and from our point of view it is very attractive. We can not talk about fire resistance, we can not talk about industry development, but from our point of view we recommend it.

REGIONAL SOLID WASTE MANAGEMENT STUDIES

Mr. R.C. MacKenzie
"EARTH SEARCH"
Videotape Narrative

The Grand Banks of Newfoundland . . . one of the best fishing grounds in the world, where the ocean bottom, the continental shelf, is covered with a rich, fertile soil that has continued to feed vast herds of grazing fish for centuries.

At one time this soil covered the island of Newfoundland. Now it lies on the ocean bottom, carried there by the southward advance of the glaciers thousands of years ago. When they retreated, the glaciers left much of Newfoundland rock covered and punctured with small ponds.

Perhaps nowhere else on the island is the aftermath of the Ice Age more evident than the rock-strewn barrenlands of the Avalon Peninsula.

100,000 people live here, one quarter of the island's population. That means there is a great demand for good land . . . . land suitable for agriculture, for housing and other urban-related uses . . . . where every proposed land-use scheme requires a search for the good earth.

ENVIRONMENT CANADA
presents
EARTH SEARCH

"It is simply a great pile of stinking, smoking, rotting garbage that is not covered at all."

In July 1971 residents of Marine Drive, near St. John's, began to complain about the city's refuse disposal site located nearby.

The first of their complaints to St. John's City Council noted that:

"We have been apalled at the smell of rotting garbage that engulfs our house, when the wind is from the direction of the dump. Covering the new garbage with old garbage will not do. Also, once in a while, notoriously on long weekends, a smouldering fire on the dump gets out of hand and a smoke pall covers the whole area for many miles."

City Council was aware of the problems at the disposal site. It was known that the road into the site was more often than not littered with refuse, that the garbage was not covered as often as they would have preferred and that fires did occur on occasion. But, an alternative land disposal site was not available within the City limits and the budget allocated for the disposal operation was too small to allow any significant improvements to be made.

So, the complaints continued. One year later, on July 9, 1972 a petition, signed by 150 residents of the area, was delivered to City Council.

On July 30 "A fire yesterday at the city dump burned for nearly five hours before it was brought under control by a water bomber from the forest fire services."

During the summer the city engineer prepared a report on the disposal site. In it he said: *"The landfill site contains 460 acres and is located 4 1/2 miles from the centre of St. John's and 1*

mile outside the city limits. The area is generally rocky, having little over-burden. The site is in a deep ravine which drains to the Atlantic Ocean at Robin Hood Bay. Operations began there in 1963."

Included in the engineer's report were the results of drilling tests which estimated that earth cover material remaining on the site would last until late 1974. After that time cover material would have to be brought in from elsewhere.

The engineer recommended that potential sources of cover material be investigated and that financial assistance be requested from the federal and provincial governments should it become necessary to relocate the dump.

Following meetings between the city and the provincial government, a tri-level meeting was held on February 6, 1973. Representatives from the federal, provincial and municipal governments agreed to hire a consulting engineering firm to study the solid waste management requirements of St. John's and surrounding communities.

An invitation to submit study proposals was released on February 8th. By late February a consultant had been selected.

A steering committee was organized to provide direction to the consultant. On it were representatives from the City of St. John's and several nearby communities, the Newfoundland Department of Provincial Affairs and Environment and Environment Canada.

Terms of reference for the study and its objectives were developed, the principal objective being the development of a plan for a waste management system to serve the study area for 20 years. Of course, the system had to be commensurate with the ability of the area to finance and support it.

The study area was defined as the St. John's Urban Region. It was substantially the same geographic area being studied by the Province and local governments with a view to changing the form of government for the area. It included the northern portion of the Avalon Peninsula, covering 452 square miles and occupied by 135,000 people.

In assessing the general characteristics of the study area the consultant reported:

"Probably one of the most significant aspects is the limited amount of over-burden covering the base rock of the region. The result is that there are many parts of the region where disposal sites could be developed with a minimum of interference with the environment if only there was a reasonable depth of over-burden. One of the prime tasks has been to determine the presence of over-burden and its depth on a broad scale."

A study of anticipated population growth and solid waste generation revealed that by 1991, the estimated population residing in the study area could increase from 135,000 to 200,000 persons.

The solid waste generated by those individuals and by anticipated industrial and agricultural activity was expected to double, at least, during the 20 years 1971-1991. 310,000 tons of solid waste are expected to be produced in 1991.

The consultant surveyed the state of solid waste disposal in the study area and found that the following conditions prevailed in July 1973.

"The Robin Hood Bay site is described as a sanitary landfill operation. That may be the intent. In fact, due to a lack of over-burden and lack of sufficient expenditure, conditions are unacceptable by normal standards and they cannot be described as being part of a sanitary landfill operation."

"Due to the severe shortage of over-burden, practically no filling is done over the waste material. Usually any that is done is the result of a quantity of construction debris arriving at the same time."

In addition to the city dump there are five locations in the study area which have been approved by the provincial government as refuse disposal sites.

One of these, the Torbay Municipal Dump, is according to the consultant:

"located on the high side of a road in an old borrow pit. Operations are visible from the road. Waste material is not covered and burning is deliberately done at irregular intervals."

The consultant continued:

"The Bay Bulls Dump is located west of the main highway on some of the most conspicuous ground in the area. It can be seen for miles. Vehicles enter the site directly from the highway and discharge their loads over the side of a cliff. No covering is done."

"The Holyrood Municipal Dump is located near the Trans-Canada Highway in a small abandoned borrow pit. Residue from a municipal incinerator located on the site has been spread nearby but has not been covered. Because of its unsatisfactory performance, the incinerator was eventually shut down."

"A new incinerator located near the Fox Trap Road replaced a nearby dump."

The consultant observed: *"Unauthorized dumping sites are located throughout the area, 150 of them having been identified in the course of the study. They are to be found beside back roads, along the shoreline and even along the sides of main roads."*

The proliferation of illicit dumping sites and the difficulties experienced at some approved sites with people dumping refuse outside the gates after normal operating hours, was evidence that waste collection could probably be improved.

"A survey of collection practices within the area revealed that the City of St. John's has a twice-weekly collection of residential wastes employing 16 cubic yard packer trucks with a 3-man crew. The Town of Mount Pearl uses a similar system."

The consultant went on:

"In the smaller communities within the study area refuse is generally collected by private contractors. Householders pay through taxes or directly to the contractor. The service is only marginal in some locations, however, as collections intended to occur once a week tend to become once every two weeks or once a month. The vehicles are usually stake body trucks, often uncovered."

So . . . . the estimated volume of refuse which could be produced over the next 20 years was now known. And the consultant could now concentrate on choosing the best treatment and disposal method from a number of available alternatives.

The consultant was required to determine whether reusable materials could be recovered from the waste and whether these materials could be sold at a profit.

About 40 to 50% of household refuse is paper, including newspapers, magazines, wrapping paper and cartons. On the surface, at least, it appears that half of all household refuse could be recovered and reused. However, those segments of the paper industry which consume wastepaper in their manufacturing processes can use only certain types of paper. Obviously, wrapping papers, milk cartons and the like which are contaminated with food cannot be used. For various product-quality reasons, the only types of wastepaper which can readily be retrieved from household refuse and reused are newspapers and cardboard cartons.

None of the paper product firms in Newfoundland is presently using in its manufacturing process wastepaper from household refuse.

The nearest company which can use a small volume of this waste is located in Nova Scotia. It was established that the cost to ship the wastepaper exceeded the purchase price offered by the buyer.

When other commodities were considered, a similar bleak picture emerged.

For example, the quality of scrap steel acceptable to a steel mill must, like paper, meet certain specifications. Just any old scrap will not do.

The only company in Newfoundland, the Newfoundland Steel Company, which used scrap in its process has closed down because it was unable to obtain enough scrap from local sources to continue operation.

Again, investigation of the nearest alternative market in Nova Scotia revealed that the current purchase price was less than the shipping costs from Newfoundland.

Therefore, it is unlikely that reusable materials may be profitably recovered from the area's solid waste. This means that a treatment and disposal system designed for the area must be capable of handling the ***total*** amount of waste which is expected to arise.

According to the consultant:

"Several larger cities in Canada and the United States have constructed heat recovery incinerators which burn refuse to produce steam. The steam can be used directly to heat buildings or can be used to produce electricity. The nature of the heat recovery incinerator makes it an expensive method to get rid of solid waste and only those communities which have enormous volumes of waste and a ready market for the steam can justify such a unit. It is foreseeable that as conventional fuel costs rise the value of refuse as a fuel may become competitive, but at present this approach is impractical for St. John's."

The consultant considered several alternative treatment methods such as shredding, baling and incineration. Each system is a method of reducing the volume or the size of the solid waste and must be accompanied by ultimate disposal of the shredded or baled or burned material in a sanitary landfill.

The consultant estimated the cost per ton of each of these treatment methods and compared them to the costs of landfill disposal where no pretreatment was employed.

The costs show that sanitary landfill disposal is by far the least expensive method.

This meant that sanitary landfill would likely be the most practical means of refuse disposal for the area for the foreseeable future.

It also meant that the consultant had a difficult task ahead--finding a site which contained sufficient earth cover material.

The consultant began a general review of the entire region to locate prospective landfill sites.

Over 20 sites were identified as potential locations.

Each was subjected to a series of tests to determine a relative ranking and to be certain that some major requirements were met. One of these requirements, established by the Ministry of Transport, prohibits the operation of a refuse disposal site within 6 miles of a major airport. It is well known that

birds are a hazard to aircraft and that they tend to congregate at landfill sites. This, effectively restricted the location of a new landfill site to an area south of the city.

Some of the other factors which were considered were:
Land Acquisition and Use
Access to the Site
Amount of Over-burden on the Site
and Land Cost

By weighing each of the factors, the list of prospective sites was reduced to three primary candidates: Freshwater Bay, Leary's Brook and Ruby Line.

A site at Freshwater Bay would have required a journey over extremely difficult and potentially hazardous terrain.

The Leary's Brook site was near a residential area and was within the urban drainage area.

By superimposing these and other factors such as haul costs and the use of transfer stations, the most desirable site for a regional landfill site became the Ruby Line location.

The consultant stated:

"The Ruby Line site extends over an area of 570 acres. The over-burden, which is a coarse gravel, is present to an average depth of 7 feet. A short paved road provides access to the site. This road connects to Ruby Line near the Harbour Arterial Interchange."

"The site is at the uppermost end of a drainage basin, downstream of a recreational area and outside the urban centre drainage area. It is anticipated that there will be no difficulty in maintaining adequate control over leachate."

"The site is upwind of the city, but all potential sites were as well. However, if the site is properly operated as a sanitary landfill, odour and blowing debris should be of no concern."

"The site is surrounded by forest and cannot be seen from any of the nearby highways."

Having chosen the regional sanitary landfill site, the consultant then recommended the addition of certain elements to complete the system for the entire study area.

It was recommended that several modified landfills be established to accept ***non-residential wastes*** at certain selected sites.

The consultant also recommended that collection service in the area be upgraded to the level of service being provided in the regional centre.

Further, it was recommended that consideration be given to construction of a transfer station sometime beyond the 20 year period of the study forecast.

The consultant attempted to wrestle with the complexities of management in the absence of a level of government below the provincial one which could co-ordinate and manage the plan.

The hope was expressed that the management of the proposed scheme could come from a cooperative venture on the part of all the municipalities concerned.

The consultant's final report was presented to the Steering Committee in March 1974 . . . . in time to begin the closure of the Robin Hood Bay dump before its supply of over-burden is exhausted.

The consultant has provided the parties to the study with one solution . . . . a solution addressed substantially to economic and environmental considerations.

Implementation will depend upon social and political considerations . . . . input from the public and the representatives of the public.

Based on previous solid waste studies it is predictable that the final decision will not be reached without compromise and confrontation.

Produced with the cooperation of

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City of St. John's

Government of Newfoundland and Labrador,
Department of Provincial Affairs and Environment

Environmental Protection Service,
Atlantic Regional Office

QUESTION PERIOD: REGIONAL SOLID WASTE MANAGEMENT STUDIES

Question: **(Mr. Benoit)** What has been the progress on the recommendations? I am just curious to see. . . . . you know, recommendations for a landfill take a long time. I wonder if this is the experience elsewhere?

Answer: **(Mr. MacKenzie)** As I understand it, after the report was submitted, the provincial government decided that they should have some public meetings where they would announce results of the study to see what the people's reaction to it was. After one or 2 public meetings I understand they put the report back upon a shelf and they decided to let the municipalities solve their own problems. As far as I know that is where it stands, and as far as I know Robin Hood Bay is still being dug away at.

Question: **(unidentified)** Why do politicians have to interfere in these things?

Comment: **(unidentified)** That is not politicians interfering, that is citizens interfering.

Comment: **(unidentified)** Citizens that have no input. Why does it have to become a political issue?

Comment: **(unidentified)** It is always a political issue. The concerns of the people are political issues.

Comment: **(unidentified)** Not necessarily, it is not what the people want, it is to satisfy the political aspirations of a certain politician usually.

Comment: **(unidentified)** Sometimes that happens.

Question: **(unidentified)** We now ideally understand how sanitary landfill operations should work and this is just wonderful. We are all pleased to get this information. Now, can you tell me who is going to take the bull by the horns and do something to clean-up New Brunswick?

Answer: **(Mr. MacKenzie)** There was something I wanted to say yesterday and I simply forgot and a lot of questions have revolved around this fact that I did not elaborate on yesterday. I guess I did not bring it out because I assumed that it was common knowledge. At the risk of being redundant let me point out that in 1867 we had Confederation which was expressed in the British North America Act which is basically our constitution. In that act it said that responsibility for land use goes to the provinces, which means that we as representatives of the federal government can come down here and lay all this wonderful stuff on you, but we have no regulatory power to do anything with respect to that subject. So, I have to appear as though I am passing the buck when you ask that kind of question. That kind of question is primarily the responsibility of the province. The province of course can get whatever they can get out of us, but the responsibility is not ours. That is not our choice but that is the way it is.

Comment: **(unidentified)** It seems that everybody takes that attitude - the responsibility is not ours - the provincial government had the responsibility for the dumps, took it from Highways where I do not believe it belongs in the first place, and put it on the municipality no matter how small the municipality is. You are not going to get progress when you do that kind of thing because each individual little municipality can not set up an operation like that. The ideal thing is obviously regional landfill operations picking up from all the small municipalities.

Comment: **(Mr. MacKenzie)** It is coming there is no doubt about it.

Question: **(unidentified)** It is coming but by whom? It is certainly not coming from the Department of Highways because, budgets are being cut, they are not going to be able to do anthing. Is that not the responsibility of the Department of the Environment of the province of New Brunswick? Instead of initiating studies and setting down all kinds of lovely policies and things, why don't they do something?

It is just that nothing gets done, and everybody sits back and makes policies. Technically, in our particular area, if there were a regional dump it would be less cost to us as a municipality to fill up a transport truck and ship it off to the regional landfill operation. It would be less cost to each municipality. The large centre that had the regional dump, it would be a larger cost to them but they would just put that off on us anyway. It would be a shared thing. But, if the Department of the Environment is so concerned about cleaning up the province once a year and this sort of thing, they are the ones that will have to do something. In the study they recommended that all the individual municipalities form a co-op and initiate the beginnings of a study. That is not going to happen. You can not expect every little municipality to select a representative and get something done.

Comment: **(Mr. Benoit)** I think your idea is sound. The regional system is the way we are looking toward. I think your idea of regional sanitary landfill where a lot of the municipalities go is basically what we are leading to and we are doing some studies on this on the east coast of New Brunswick. Now we hope to do the whole province but before we do the whole province we want to see some implementation somewhere else. We are working on it.

Question: **(unidentified)** Your study has to go to the Department of Highways because they are in charge of implementing the dump, right? Is that what happens next after your study is completed?

Answer: **(Mr. Benoit)** No, it is a joint effort between the provincial government as a whole and the municipality. The two levels of government have to join together and do something.

Comment: **(unidentified)** The province is really good at making good decisions like, the municipalities are responsible for the dump. Dump it on them. The municipalities are responsible for the streets. Dump it on them. Well, then why don't you tell the municipality, "You are responsible for setting up a decent system," and dump that on them. I mean, get it done.

Comment: **(unidentified)** If you had enough money to go ahead and do it.

Comment: **(Mr. Benoit)** We do not make the policies, as you know. But we have to live with the policies.

Question: **(unidentified)** Two studies have been done or are being done. Two specific areas I understand. Have either of those gone to the Department of Highways for approval?

Answer: **(Mr. Benoit)** Everybody in the government, the various departments are aware of the recommendations. The municipalities in the area are also aware, but it has not caught on yet.

Question: **(unidentified)** Has there been given approval or denied approval?

Answer: **(Mr. Benoit)** By approval, the recommendations were accepted by various departments. Now, we have to have some agency to be responsible for implementation along with the municipalities.

Question: **(unidentified)** Who is responsible now - the Department of Highways?

Answer: **(Mr. Benoit)** For those rural towns, which are not municipalities.

Question: **(unidentified)** Does it not make more sense that the Department of the Environment should be in charge of that sort of thing? Implementing things not just making the rules.

Answer: **(Mr. Benoit)** There are some various thoughts on that. A lot of people say Environment should do it, a lot of people think that Environment should be strictly regulatory in power and be like the police and say "you can not do this or you can not do that".

Comment: **(unidentified)** Do not get involved.

Comment: **(unidentified)** You do not pick up the garbage, but you set up the system. You are the experts on this problem, surely you could help each municipality or region.

Answer: **(Mr. Benoit)** Environment is a young department and we are getting organized. I can not speak for the government on what they want to do with the environment.

Question: **(unidentified)** When can we look forward to seeing a system of regional sanitary landfills throughout the province? Operating?

Answer: **(Mr. Benoit)** I would think within a year or two - that is my opinion.

Question: **(unidentified)** Operating? I mean throughout the province. When can we hope to see the problem solved?

Answer: **(Mr. Benoit)** We will not see the problems of garbage ever solved. There will always be something. I think we can make some progress, I am sure. I do not think you will see New Brunswick as the totally ideal situation. Ontario has problems, I am sure. I am sure every place has problems and they are more advanced than we are in disposal.

Comment: **(unidentified)** This is the sort of thing where for once let us be progressive and get it done. Show everybody else how to do it.

Answer: **(Mr. Benoit)** We are moving that way. I think that this is the type of seminar, this is the first one, to make people aware of where we are heading.

Question: **(unidentified)** So where can we find out where you are heading, and letting us be aware of it? In other words is there any public participation in Caisse Cape and the area through there we are talking about?

Answer: **(Mr. Benoit)** Through municipalities . . . .

Question: **(unidentified)** Forget those characters. Let us say public participation. You, me, the taxpayer. Are there meetings where the average Joe can go and find out what you are doing with his tax dollar?

Answer: **(Mr. Benoit)** Well, I believe enough know we have a Department of Environment.

Comment: **(unidentified)** I disagree with you because I checked last night with a fellow from Caisse Cape about this and he said he did not know anything about it. Now, you are saying there is a study on that. In a regional type of thing in the Westmoreland county area and he comes from on the border line of Westmoreland and Kent.

Comment: **(unidentified)** MacLaren Atlantic are doing a study on that now.

Comment: **(unidentified)** There is no public participation as such.

Comment: **(unidentified)** Well, I do not know but I do know that MacLaren Atlantic are doing a study on Westmoreland.

Comment: **(Mr. Benoit)** I think that most of the people know.

Comment: **(unidentified)** Can I make a suggestion? There are two examples of plans that went sour because there was no public participation, no public meetings, you know the one at St. John's, and the one that we talked about yesterday. I think it would be good to have public participation.

Comment: **(Mr. Benoit)** You know we are still at the planning stage. We are not . . . .

Comment: **(unidentified)** Now is the time to do it.

Comment: **(unidentified)** That is the most important time to have public input in the planning. Now MacLaren Atlantic will come along and we have numerous examples of that in the province of New Brunswick. Make a report. A lot of the reports have not been accepted by the general public. It does not include my ideas, it does not include my neighbours' ideas, it does not include my community's ideas and that is after the plan. You do not have to wave banners and one thing and another the interested people will come around early in the stage. People will come onto a planning process at the time that they are interested and it will affect them eventually. Unless you initially start them out in the planning section and if you want a prime example of it take a look at the Saint John River Basin Board Study, where they came on early and they are still on, and will be until a plan is designed and we are nowhere near implementation of the river basin program.

Comment: **(Mr. MacKenzie)** I would like to interject if I may, because I do want to keep this thing rolling again, I would just like to . . . .

Comment: **(unidentified)** You are going to interject into something that is the most important thing in this whole program.

Comment: **(Mr. MacKenzie)** I would like to add to what you are saying and twist it a little bit because in that St. John's study one of the things that the consultant did very early, I think probably the first thing they did, was they publically advertised that they were going to do the study and that anyone who had any input into it was to write in. Now what they got were all the people who had been objecting for two years to the dump. They wrote in and objected again which is fine - that is fine - because after all that is how the thing got going. That was it. There was a time limit put on when those objections could be received. The time limit expired and they got the objections. The public had their chance, the public responded to a certain degree. The consultant continued with his studies, he made his recommendations, after the recommendations were made then the provincial government went back to the public. Now, I am not necessarily agreeing that the public did not have a chance.

They had two chances, but what killed it was not the objections because you are always going to get those objections, what killed it was the lack of conviction. Somebody did not have the courage to say, "Ok that is it, now we are going, we are going to do something." That something has not been done and that same deplorable situation that was objected about in 1971 persists today.

Comment: **(unidentified)** The fellow that made that situation should have been hung from the highest mast in Newfoundland. The reason that the people objected to it was because they had no knowledge. How many times did they take a program such as you are presenting right here out to the people before they initially asked them for their reaction, because the only reason they objected was the fear of the unknown.

Comment: **(Mr. MacKenzie)** That is right.

Comment: **(unidentified)** And, unless you educate and make information available to the general public they are going to say "go to Hell" and I do not blame them.

Comment: **(Mr. MacKenzie)** No one blames them at all.

Comment: **(unidentified)** You have got to give people information.

Comment: **(Mr. MacKenzie)** There is a point. I said yesterday you might as well put the dump on wheels, because you are always going to have somebody who does not like it. Somewhere along the line you have got to make a decision. That was not done.

Question: **(unidentified)** How could you make a decision without giving the people an opportunity to cooperate?

Answer: **(Mr. MacKenzie)** Well, I am arguing with you that they did have that chance. They had been squawking for 3 years prior to that.

Comment: **(unidentified)** Not on a continuous basis did they have that chance though and that is where it fell down.

Comment: **(unidentified)** If we are wrong and all of the people in Canada are wrong, what you should do is work through Information Canada, try, as a resource for yourself to get the papers out on the Man and Resources Program, which was conducted Nationwide here and find out how they need information and data to make a decision. Without that you are not going to get the public to go up against that report because they are not experts. They have a bias and that is all they have and that is all they can work with. Fear of the unknown.

Comment: **(unidentified)** I just have a couple of very cynical comments about dealing with the public. We deal with 45,000 of them here every week. In this business there are two wonderful things and it is a little awkward to say we have got the garbage all home free. Then we will go again Monday and there will be the same damned amount that there was last Monday and the public will say well the clean up was this week. We do not want public participation because they want to get rid of their lawn clippings and fence posts and their wash tubs and everything else and we are not paid to take it. So public participation says a contractor will have to take fence posts, lawn clippings, and maybe even come in and help clean up a basement. If you give the public that much voice in it you are going to be running the butt right off yourself. And then nobody can get enough money, probably Raymond has avoided the subject. Dollars is what I think it boils down to right now. The public will participate until as you said, somebody, somewhere has a lack of conviction, and if they are told "go to Hell" at least on the way implement what they think is right.

"GUELPH'S SANITARY LANDFILL"

Narrative of a videotaped interview
with
Mr. Ray Funnell
City Engineer's Office
City of Guelph, Ontario

Interviewed by
K.A. Childs
Solid Waste Management Branch, Environment Canada

We are presently in the City of Guelph looking at the landfill operation. This is an interesting case in that we have both the closing off of the old site and the development of a new landfill site. The site we are presently at comprises 50 acres and has been in operation for a number of years and is currently being closed out. I have with me to tell us the details of both the existing site and the new one, Mr. Ray Funnell who is operations engineer for the City of Guelph.

Ray, what is the population here?
About 65,000.

And the site. . .I said 50 acres, I believe that is correct for this existing site.
That's correct.

How many years has the site been in operation?
Somewhere in the neighbourhood of 15 years.

When the site was originally developed have you any idea of the thought that went into the selection of the site and the thought that went into the development of the site or was it the normal level of expertise applied at that time which was pretty well nothing?

I would say it was a site that was selected that was reasonably close to the City and probably land which was at a price which the City could afford at the time.

I see. So at that time then the environmental considerations were really not that important in their considerations, it was availability and it appeared to have the capacity that would last them a number of years.

That is correct.

Maybe you can just tell us here how you are planning on closing out this particular site and if you have any plans for its use after it is closed off.

We are presently trying to contour the site, putting various lifts of garbage in so that you have proper drainage. Following that we will be putting 2-3 feet of cover material. Part will be top soil over the area, levelling it off and seeding it. There is a possibility this will become a park area later on but no definite decisions have been made on that matter.

Has there been any attempt made to monitor any of the pollutants that might come from the site, both liquid and gaseous?

At the present time we are establishing monitoring on the drainage system through the landfill site to determine the quality of water entering and the quality of water leaving.

I was involved in this site a couple of years ago in a different capacity and we were looking, at that time with the City of Guelph, at the development of a new site. To what extent did this existing site, its location, influence your decision on the acquisition of a new site?

We are happy as far as location with the existing site. It is reasonably close to the core of the City which saved naturally, getting into any problems with long runs for the packers or any thoughts of getting into transfer stations.

As far as this site is concerned, do you believe that the operation of the past will allow you to develop it for anything other than park land? I would be rather hesitant, personally, to see it used for structures. I am sure there would be problems with settlement here and that the type of standard of operation that was employed in the past probably will encourage or will not eliminate the problem of settlement. Do you think that might be a problem?

Yes, I could foresee a problem of settlement and actually if buildings, if they were put on it, would have to dig down to reach firm foundation which would mean tremendous footings. I think the proper use for it would be some passive use such as parks for some number of years anyhow.

This site has been here, you said 15 years; that takes us back to the late 1950's. When did the City start looking around for the new site?

In the late '60s.

And it has taken 4 or 5 years to get to the point where you are almost ready to go into the new site. Is that correct?

That is correct. The approvals for the new site were given in late 1971 and we sort of bided our time with working on drainage plans and drainage systems and now we are at the point where within a couple of months we should be using a new site.

This site here has been operating for some number of years and then the site you are going into is immediately adjacent. There were many objections to this move. Have these objections been overcome now?

Yes, with the development of the new site we are taking care, in every possible way, to be sure that the leachate from the garbage does not enter the groundwater system and in addition, we are making every effort to make sure the garbage is kept covered daily and also to assure that, except for right in the localized dumping area, the smells are eliminated.

The land to the South of here is fairly open but the land to the North is subdivided with housing development there and it is continuing to expand. This is the area from which you received most of the objections I believe?

Yes, there is a subdivision in the Township of Guelph immediately to the North where most of the objections to proposed extension to the landfill site came from.

In all of the applications and in all of the approvals, I imagine you had to give a commitment to operate this to a particularly high level, high standard at least, and the site development had to satisfy the demands of the people. If it were going to be here they would be looking for screening. I imagine all of these points were given consideration during the approval procedure.

Yes, we have planted screening around the site and in addition we are taking precautions to prepare the cells properly so that we are picking up our leachate and disposing of it and doing everything in our power to assure that it does not reach the groundwater.

Thank you Ray. I would now like to go back and take a look at the drawings of the new site and maybe we can take a look at the plans you have for that development.

.....

We had a look at expanding the site, keeping in mind the proximity of the existing site to the downtown area. Being about three miles from the centre of the City and 5-6 miles from the extremities we looked very seriously at expanding the existing site. In the early '70's we took a look at acquiring another 150 acre parcel adjacent to the existing site to expand the site to a total of 200 acres, keeping in mind the proximity of the downtown and trying to keeping our haul distances down.

Did you serve any people out here in the townships?

Yes, the Township of Guelph deposit their refuse there as well as the Village of Rockwood.

They are coming in from the East, so did you look at them in terms of problems they might have for haul distance?

Our main concern was the City of Guelph.

As I understand it, this whole area is a discharge area, hydrologically. In other words, there is an outward component of the groundwater. This undoubtedly has caused some real problems in site development, site planning and I guess this was even more complicated or further complicated by the fact that the drainage to the North and Northeast fell towards the site. I wonder if you could just describe how you plan to look after both the groundwater and the surface water that influences this site.

As you say, the drainage from the other areas flowed into the landfill site area with the low areas of the land which was acquired and, in fact, some of the older area being swamp area. One thing we had to accomplish was reducing or lowering the groundwater level and getting rid of the surface runoff. So we undertook to build a major drainage ditch through the site along the boundary line and then across the site through a 60" pipe which was then discharged South of Eastview Road into open ditch again and flowing toward the Speed River.

This line through here is an interceptor ditch isn't it for surface water?

Yes, an interceptor ditch for surface water. That is correct.

How about the surface water in the roadways here, does that influence the site at all or is that kept beyond the limits of the site?

We keep picking it up beyond the site limits.

Do you anticipate working problems because of the high groundwater table or do you think that these ditches will lower it sufficiently?

From experience, the groundwater has been lowered sufficiently and before going into areas we have put local storm sewer systems into the cell areas, thus lowering the water table even further.

This plan is showing us the various sections of the site and how you plan to utilize them. This area that you identified up here, this is the highest part of the site as I understand it, and this is the area that has the clay soils and these are the soils you will be using for cover material and for sealing the bottom of the site. Is that correct?

Yes. In preparation of the new cell, the trees were dropped on site to provide a pad and we also dumped in building rubble in what was swamp conditions, to try and harden it up. Over top of that we placed three feet of the impervious material out of this area to seal the area where we are going to place the garbage from entering the groundwater system.

I imagine that the City did fairly accurate computations of the material that was available, looking at it in terms of yardage to make sure they had sufficient for cover and for sealing. You will not be in a position of having to bring cover material in throughout the lifetime of the site. Is that the intention?

That is our hope. But we are taking material from outside and holding it for cover material when it becomes available.

Are you able to use any part of the swampy area for final cover or is it a write-off, if I might call it that?

Basically the old site is a write-off. We are now in the process, as you have seen, of shaping the area off and we are going to cover it and get a grass catch on it.

You have identified the cells in here. This is the sequence of development you will employ and I imagine that this is reasonably flexible that if circumstances demand it you will develop the cells as conditions determine from time to time. Is that correct?

Yes, we are trying to develop it in such a way that we do not clear any more than we have to and further that we can work our leachate collection system and our storm drainage system without having to do any dead runs.

With cell one, which we will be taking a look at on site, we are presently in the process of pre-loading. We have not only placed the three feet of impervious material but we are proceeding to place approximately 10 feet of material so we can monitor settlement. We hope to get all settlement out of the swamp area below before placing the granular and drainage layer on so that this drainage layer won't be pulled out of shape and lose its effect.

Will this be a continuous process, in other words, when you work in the low area, you will be pre-loading?

We will be at least pre-loading with a 5-foot layer. We got a substantial settlement when we placed the first 5-foot layer on very early this year. The second layer is presently being placed and if we get little settlement for the second 5-foot lift we will probably step around this procedure in the future.

I see, but staying with a 5-foot lift?

Yes, it will depend on what we see.

Ray, this is a typical cross-section through the refuse cells. I wonder if you could describe the pertinent points here and indicate how a cell will be developed.

As I mentioned earlier, the material below the organic swamp material is a sand-silt material and then we have the swamp material on top covered, in many cases, with trees. We have dropped the trees into the organic matter. In addition we have placed building rubble trying to stablize and harden up the organic matter. On top of this, in the end, we will have a three-foot layer of the impervious material to seal out any of the juices from the garbage from entering the swamp material and on into the groundwater table below. As I mentioned earlier, we are putting in up to 10 feet of this material initially to pre-load and we will be removing down to the three-foot lift. After we've removed excessive material to leave us with the three-foot seal, we will be shaping the three-foot seal area in such a way to provide drainage toward our leachate collection system and we are placing a foot of granular material on top of the seal which will allow percolation of the leachate from the garbage and then we will be commencing to build our garbage cells on top of the granular lift.

There are 10-foot lifts roughly?

Roughly.

And you have three lifts here with a seal in between or is this just an intermediate cover?

It's an intermediate cover which will be part of our daily cover. We cannot work any more than a 10-foot base at any one time.

The final cover. . .will it be some of the impervious material and then some top soil?

Top soil on which we can put a catch of grass.

How deep is that final cover?

2-3 feet.

Ray, I see you've planted some trees around the site. Do you plan to landscape the site?

Yes, much of the site was initially surrounded by trees. We are trimming up the existing brush areas which were not surrounded. The City invested some $30,000 in planting trees around the site which will screen the landfill site area from existing sub-divisions and the existing primary roads. You will also note we have a drainage ditch along Eastview Road which also is the same around Speedville Avenue to take care of road drainage and any surface water which runs off from the landfill site.

The leachate collection system. . .do you plan on having a collector ditch for it around here and do you have a collection basin?

Yes, there will be a collector tile system between the trees and the edge of the cell which will carry it to, initially, a holding tank which we will pump out on a regular basis. If the day arrives when sewers are available and we're willing to accept it into our system we'll probably pick it up in this manner.

I think I should point out that I noticed that the drawing has 10:1 exaggeration so that if we look at this it seems to be a fairly high hill. Undoubtedly there has been some thought given to matching this in with the surrounding topography. It's not going to be a bump-on-the-horizon sort of thing. It shouldn't be too noticeable. Is that correct?

It's very tempting to hold it in so that the site itself drains properly but won't stick up like a sore thumb.

This is the general plan of the whole site, and it also shows us, in some detail, most of the features that will be associated with the site. I think there are some points on here that we should discuss in terms of site facilities.

It's possible to go back into the area of the trees. This plan probably shows better the existing tree area and where we have taken steps to plant a perimeter screening in this area. We will also be doing some improvements around the entrance. This being the main entrance to the site. The weigh scales are established at this point. An access road is being built to provide access into the new cells and we are establishing our equipment buildings in this area. It will be a maintenance area for equipment. Currently our trailer lunch room facilities for the collectors and people who work at the landfill is established in this general area. We will be moving that over to the area of the shed. We also are intending to pave approximately 400 feet in from Eastview Road this year. To tidy up the entrance to the site, we will do some plantings around the entrance and we are also going to establish a fenced area where the people coming with private cars, particularly on Saturday, will not be going to the face to dump their refuse but we'll be putting an area there where we'll pick it up and take it to the face and cover it. In addition, we will be completely fencing the site with chain link fence. In 1974 we will be completely fencing Speedville Avenue frontage and across cell one. It is hoped that possibly, in '75 or at least by '76 we'll complete the fencing of the total site to provide for security, keep out scavengers, also security for equipment.

I noticed here that the early development will be in the area where the trees already existed, and the later development would be in the area where you planted the trees. So you are working towards the point where the working areas will be screened at all times.

We are hoping to keep this area screened from both the motoring public and also people who live in proximity of the landfill site.

This area down here right now is not too developed is it?

It's under farming use at the present time.

. . . . . .

Ray, we're back out at the site. We're on part of the new site. I believe we are standing on the area that is to be the first working area- the first cell. Would you describe exactly what you are doing here in preparation for the first load of waste to come in.

Well, initially the area was in swamp. We put building material and other rubble plus the trees that were on site into the swamp to try to build a working pad. Over top of that we presently have about 7 1/2 feet of impervious material. All except three feet of it will later come off. We are placing the excessive depth for pre-loading to take all the settlement characteristics out of the swamp material prior to placing garbage on it, so that when we place our drainage pad it will stay at the grade we put it at or near to it so that we bring our leachate to a collector system.

Ray, the pipes right behind us here. . .these are the settlement gauges so that you keep a record of the level to which you constructed the super-imposed load and then you will be able to determine the degree of settlement you achieve?

There are feet on the settlement gauges resting basically on the swamp area and we are able to monitor the settlement which takes place. In other words, if the swamp area settles the settlement gauges will also be pulled downward and it will monitor the settlement taking place in the swamp material below.

Right now you say that all but three feet of the material presently here will be removed. Relative to where we were standing right now, how much higher will the final elevation be from this level?

Approximately 20 feet.

That includes the top soil, top dressing, the final cover?

Yes.

. . . . . .

Well, Ray, now we're standing in part of the drainage system and this is the top end of the system where it intercepts with one of the road ditches I believe.

That's correct. It intercepts with the road ditch from Speedville Avenue and also provides drainage from the subdivision to the North.

The ditch has been constructed sufficiently deep to lower the groundwater as you have experienced a lowering of the groundwater table since you put the ditch in?

A very substantial lowering of the groundwater.

Do you anticipate any problems in the future when you start to load the area with refuse so that you may get this mounding of groundwater and the ditch will cease to function in a way that it's presently conceived of?

It's not beyond possibility, but we're hoping not.

You mentioned that the ditch here will provide drainage to the subdivision. This is the same subdivision that was involved in most of the opposition to the development of the site?

Yes it is.

Did they have drainage problems before the site was developed?

Yes they did, and they still do.

This is just a matter of really no adequate outlet for the surface water in the area. It is just ponding there. There is a particularly high water table there?

Yes, they also realize too that they have a problem with their spectic tank system.

There is no risk that effluents from the septic tanks are going to find their way into this drainage course?

The residents of the subdivision are presently looking into a way in which they can possibly get into a sanitary sewer system.

Going back to this main ditch going through here, as I recall the drawings we looked at. . .there is some point through the site here where it is picked up into a 60'' sewer pipe. Is my memory correct?

That is correct.

But this discharges back into an open ditch later on at the South limits of the site.

Yes it discharges into an open ditch at the South end and flows onward through various culverts to the Speed River.

I think we have got a pretty good picture of the whole development now and I think we have demonstrated that in the development of a fairly large site to serve a reasonable sized community that refuse just cannot be deposited there on the land. There has to be a fair amount of thought given to it. I think we've been able to demonstrate here that the environment has been reasonably well protected. In fact, some areas may even benefit by the development of the site by improving some of the drainage characteristics of the area.

REGIONAL REFUSE COLLECTION, TRANSFER AND DISPOSAL

Mr. J. Payne

INTRODUCTION

The problems associated with the increasing quantities of solid waste being generated and the pollution resulting from its disposal have revealed the restrictions of dealing with it within arbitrary political boundaries and the advantages of regional systems. Regional solid waste management has the potential for:

1) economy and efficiency of large scale operation including the practicality of incremental system development;

2) better co-ordination with comprehensive regional planning including optimization of disposal systems to best fit topography, geology, highway systems, etc.;

3) better opportunity to effect resource recovery and develop market opportunity for reclaimed materials; and,

4) recognition of the disposal needs of communities having no disposal site within their boundaries.

EXAMPLES

The trend to regional systems is evident throughout the western world.

1) **Canada**

In Ontario, the majority of regional governments established over the past few years have been given authority over refuse disposal. Typical clauses in the regional government act read as follows:

"On and after the 1st day of January, 1974, the Regional Corporation shall provide facilities for the purpose of receiving, dumping and disposal of waste, and no area municipality shall provide such facilities."

"The Regional Corporation may acquire and use land within the Regional Area and may erect, maintain and operate all facilities . . . . for the purposes of receiving, dumping and disposing of waste . . . . and all such existing facilities and lands of a local municipality to the extent that they are used for such purposes vest in the Regional Corporation on the 1st day of January, 1974 without compensation."

In several cases the power is only granted if a local municipality so wishes, cf:

"Where an area municipality has requested the District Corporation to provide facilities for the purpose of receiving, dumping and disposing of waste, the District Corporation and the area municipality may enter into an agreement for the use and operation of such facilities."

The Province of Ontario also gives encouragement by providing 50% funding of solid waste management studies, only if the study addresses itself to regional considerations.

In Quebec a regional community "may establish, possess and operate garbage disposal centres within or without its territory . . . . From the time when such a garbage disposal centre is in operation, no municipality . . . . shall grant or renew a contract for garbage collection unless the method of disposal . . . . has been approved by the Community."

Also "the Community . . . . may compel the municipalities in its territory which possess garbage disposal centres to make them available to other municipalities for a compensation fixed by the Community and upon approval by the Quebec Municipal Commission."

In areas of Quebec where regional governments do not exist and an inquiry has established that there is an obvious advantage, under the Environmental Quality Act the Minister may "order that a system of waste management or part of it may be operated jointly by two or more municipalities."

The latest regional facility to be built is the incinerator in Quebec City which sells steam to a local industry.

In P.E.I. a regional system consisting of four regional sanitary landfills and 45 container sites will soon replace over 200 open dumps, with obvious environmental and aesthetic benefits. Municipalities and incorporated areas will be required to provide a collection service with the Province operating the landfills and container sites.

2) **U.S.A.**

28 of the 50 state governments actively encourage regional systems and the others permit them.

3) **U.K.**

A recent re-organization of local government has made refuse disposal a regional or "county" function with collection left to the local or "district" agencies. Environmental and landfill site availability problems were the prime considerations. The local agencies must collect and deliver all wastes to the regions except for separately collected wastes such as newspapers, which they can sell themselves. The regions can then dispose or reclaim the wastes depending on the conditions obtaining.

HAUL COST COMPENSATION

In most of these systems it has been decided that collection will remain under the jurisdiction of the local government. It is considered that local governments are more responsive to the day-to-day needs of their citizens and are more aware of the peculiarities of local conditions. The purpose of regional governments, on the other hand, is not to assume customer service but to provide the major facilities necessary to protect public health and welfare and to establish economies of scale where such opportunities exist.

However, regional governments should try to establish their transfer and/or disposal facilities so that not only are the total system costs for haul and disposal minimized, but also to ensure that some of the area municipalities are not unduly penalized financially with excessive haul costs. Small municipalities or collection districts should not be expected to pay exorbitant direct haul costs in order to move refuse from their borders to a major regional facility whose location benefits the major source of refuse in the region. Excessive haul costs must be supported by the region as a whole. The subsidy to be paid depends on the situation before the region came into existence. Some compensation formulae which have been suggested for various places are:

1) **Ottawa-Hull Area**

The excess haul distance should be the shortest road distance from the waste disposal site to the nearest boundary of the collection area, minus 7 miles. Compensation should be made annually on the basis of 10 cents per capita per mile as applied to one-way mileage in excess of 7 miles.

2) **P.E.I.**

Municipal haulage costs (to the nearest regional sanitary landfill site) in excess of 5 miles will be borne from provincial operating funds.

3) **U.K.**

The formula used by the Greater London Council is:

$$\text{Payment} = 2\,RT(D - 3)$$

where R = ton–mile rate

$$= \frac{\text{hourly operating cost of collection vehicle}}{\text{average load (tons) X average speed (m.p.h.)}}$$

T = annual tonnage

D = distance (miles) from the centre of the municipality to the regional facility

RURAL SYSTEMS

Rural operations offer excellent opportunities for the introduction of regional systems. Collection and disposal of solid waste in rural areas are frequently do-it-yourself operations. It is this practice of self-service that has led to the typical rural practice of establishing a multitude of individual sites within a relatively small geographic areaa--for example, the St. John's study identified 157 sites in an area of 452 square miles having a rural population of 35,000 persons.

The rural disposal site is usually characterized by limited operating schedules, usually one or two days per week, sporadic covering of the refuse, unsightly debris around the entrance and frequent fires. When open, the sites may or may not be attended. This mode of operation has developed because of the intermittent demands for disposal in less populated areas and the economics of a facility supported by relatively few taxpayers. Frequently, the site is totally uncontrolled both in terms of access and operation.

Two solutions to the rural problem are:

1) the development of new small sites for local use, maintained by mobile crews equipped to operate them properly;

2) the abandonment of local sites in favour of a containerized scheme with wastes being taken to a nearby regional disposal site.

In system (1), each site is fenced and only open one or two days per week. Waste is delivered to the site on the appointed day(s) when the operating crew is there. This crew moves from site to site with its equipment and maintains each as a proper sanitary landfill.

System (2), utilizes the placement of either 4 to 10 cubic yard metal containers with hinged covers or large roll-on containers at convenient locations throughout the rural area. The number of containers may be readily varied to accommodate changes in waste quantities either seasonally or otherwise.

The container site should be off the travelled portion of the roadway but readily accessible from it and should be properly graded and treated with gravel or paved to provide a neat mud-free area for the users. Adequate space is required for delivery by the public and pick-up by collection vehicles. Efficient operation of the collection vehicles and effective site maintenance should be considered when preparing site design. The area may be fenced but the site should remain open at all times.

Containers may be set on grade, requiring that the waste be lifted 3 to 4 feet for deposit. Alternatively, a ramp may be provided to make dumping easier. The on-grade application makes site maintenance easier, provides for safer operation in winter and to some degree deters deposition of heavy or bulky items in the containers. The collection vehicle services the containers once or twice each week or on demand and delivers the waste to the regional disposal facility.

The relative merits of these two types of systems are shown below:

	Container System	Local Landfill System
Land Requirements	– Small parcels adjacent to road ways. May be leased.	– Sites usually must be purchased and properly finished.
Capital	– Primarily a contract system. Some development costs.	– Capital outlay for land and development.
Siting	– Flexible. Sites readily moved. May be quickly established and modified.	– Relatively fixed due to investment. Requires design and approvals. Time element involved.
Access	– Readily accessible. May be kept snowfree with rural road maintenance.	– Relatively remote.
Aesthetics	– Litter can present a problem. Proper service is essential.	– Remote location usually makes maintenance less critical.
Operating Schedule	– 24 hours per day, 7 days per week.	– 1 or 2 days per week, 6 hours per day.
Level of Service	– Bulky waste accommodated once per year. Travel time reduced as compared to the local site system.	– Bulky waste accepted throughout the year.
Environmental Aspects	– Number of sanitary landfilling operations reduced.	

In general, the container system offers the greatest degree of service to the resident, since travel distances are reduced and disposal can be effected at any time. The major drawback is the lack of bulky waste collection service except at a specified time of the year. Although the local rural site can provide for the latter, it should be realized that the mobile crew system necessitates schedules that would not provide for evening or Saturday operation. This is a major consideration in suburban areas where residents may work in the cities and cannot therefore utilize disposal facilities during normal working hours.

COSTS AND FINANCING

Where area municipalities are responsible for local collection, to recover the costs of disposal the regional government can:

1) raise all necessary monies through charging a unit rate per ton at the disposal facility;

2) impose a special charge based on the assessment of properties served by the solid waste management plan to provide the necessary revenues to support the service;

3) establish a combination of 1) and 2) with unit charges representing a charge to the generator for service and a general levy based on assessment representing property benefit through better environmental protection and improved aesthetics of the region.

Many communities use method (3) with the assessment levy being used to finance the residential portion and direct disposal fees being charged for commercial and industrial refuse.

The disadvantage of utilizing a general levy for total collection is two-fold:

1) It gives no credence to the value of the direct service rendered;

2) It puts no direct pressure on the generator to reduce quantities.

In the rural container system, however, charges cannot be based on delivered weights since no facility is available to record the frequency and weight when delivered. A general levy against assessment appears to be the most suitable method of financing for this service.

Rural container systems are usually contracted out with costs running around $1 - $3 per cubic yard per pick-up, prices varying depending on quantities, road conditions and distances travelled. The price is based on container size rather than actual quantities. For example, if the contract price is $1 per cubic yard, costs for one year for twice weekly emptying of a 10 cubic yard container would be $1,040.

Container site development costs (excluding land purchase or lease) range from $2000 - $3000 for a flat, gravelled area, up to $30,000 for a large paved area with ramps and concrete retaining walls and pads.

"MUSKOKA CONTAINERIZED SERVICES LTD."

Videotape Narrative
K.A. Childs with Don Coates

It is generally conceded that in the urban areas improvements to waste management systems can be introduced with relative ease. New sophisticated systems can be implemented, because the tax base there is sufficiently large to allow these sophisticated systems. The rural areas are an entirely different matter, for the sparse population and the usually smaller tax base frustrates implementation of more sophisticated systems. The other problem in the rural areas is that there appears to be a proliferation of waste disposal sites and a reluctance to introduce regular collection service. All of these problems; proliferation of sites, poor collection are even more greatly magnified in the areas where the population fluctuates over the year, such as the cottage areas, particularly where the populations can go up to 5 or ten-fold for three or four months of the year.

We are presently in Muskoka, and this is one of those areas that has had this problem in the past of proliferation of sites, infrequent or spasmodic collection and has had tremendous increase in population from May until October.

The Regional District of Muskoka was established in 1971 and covers an area of over 1,400 square miles. The legislation that established the region provided that waste collection and disposal remained a local government responsibility. In this 1,400 square mile area there were very many sites, most of them very poorly maintained and they seemed to develop spontaneously and there seemed to be no end to this proliferation.

In the early 1970's, at roughly the same time as the introduction of the regional legislation, a containerized service was instituted in the Muskoka area. The service was provided by a private company, Muskoka Containerized Services Ltd., and they have established collection points throughout the district. The service provided by this Company consists primarily of provision of collection boxes; the smaller boxes to serve the small communities and the cottage area and larger roll-offs to serve the more urbanized areas. These boxes are serviced as frequently as required and obviously they are serviced more frequently during the summer months when the Muskoka area receives this large influx of cottagers. The introduction of this service has allowed for the closure of many of the pre-existing sites and as a consequence, one might suggest that the environment of the area has been somewhat improved.

One of the primary aims of this type of service is to allow the people in the area to avail themselves of the service without having to drive many miles to a disposal site. This can be accomplished by providing a collection point somewhere in the area that is convenient for everybody. In this particular case, there is a small collection area with the provision of collection boxes. In this case, the boxes will be loaded onto the packer trucks using a front-end loader. This site services a small community in the Muskoka area. It should also be noted that these areas are not self-sufficient and this site has been quite badly littered by people who have abused the service. There have been mattresses and bulk refuse dropped around and the service ideally is intended for primarily domestic wastes, which can be easily loaded onto the collection vehicle.

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This is the waste disposal site serving the Town of Bracebridge. It is a recently developed site and is operated as a true sanitary landfill with daily cover. This site has replaced one of the original unacceptable sites and receives the wastes delivered to it by the packer trucks which have collected the waste from the containers.

. . . . . .

We are standing at one of the former disposal sites that has been replaced by transfer operations provided by the container service. This was an uncontrolled dump located immediately adjacent to one of the concession roads in the area and frequently the road became blocked as a result of people dumping refuse right over the roadway. This problem has been eliminated by the introduction of this transfer service.

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That dramatic demonstration shows how these roll-off containers are used. This particular roll-off is being used as an elementary transfer station and has, in fact, replaced one of the dumps in the area which was found to be unacceptable. This roll-off serves a small rural area and is serviced as required and again more frequently during the summer.

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The quantity of wastes generated at shopping centres creates a problem under normal conditions and is no less a problem in this area. In this area the contractor makes use of roll-offs for 2 types of service--1. at the rural transfer station and, 2. in this case this roll-off is located in the shopping plaza and provides service to a fair number of stores allowing the stores to deposit the waste in the roll-off and for the container to be removed as is required.

Interview with Don Coates

K.A. Childs:

I am speaking with Don Coates, President of Muskoka Containerized Services Ltd., the contractor who provides the service in this area. Don, we spent some considerable time going around looking at the various containers and sites that you have provided here and I have a number of questions with respect to the logistics of this operation.

The first one is the small containers that we see at the small community sites. How many of those small containers have you got in operation in this area?

D. Coates:

Ken, we have about 155 of them in operation. Out of the 155 basically 95% of them are with commercial and private accounts. The balance are with municipal accounts on some of the sites you have seen. They fluctuate in the summer time; we have about 8 or 9 of those sites and in the winter time we just have 3 or 4. Primarily because of the summer fluctuation of population up here.

K.A. Childs:

Have you found that these small containers have had to be supplanted by the large roll-offs because of the services that had to be provided? In other words, has the small container been insufficient or has the required frequency of service made it uneconomic?

D. Coates:

Ken, there is no doubt about it. It is uneconomical to handle refuse with the small containers for local area pick-ups. We went into an experiment a year ago, taking a whole section of a township to provide a service with those containers. We did it for 2 years. What we are finding is that with the influx of garbage on the weekends the small containers will not handle it, unless you are running basically on 7-day week scheduling. And because of the road conditions in this area it just doesn't work. Where it does work is in some very specific locations such as where island residents come into a Government dock and have to have some place to dispose of their garbage. It works very well there. We found that

in the larger areas we have had to go to the 40 cubic yard roll-off containers and we are using that transfer station idea to replace local dumps and also to provide more flexible service to the areas.

K.A. Childs:

Now, if I could talk about the roll-offs for just a minute maybe you can tell us how many you have of these and do they generally represent a transfer station supplanting an old unacceptable open dump? We have been around to a number of them and there seems to be a dump close at hand or on exactly the same site. So maybe you can just tell us how many of the roll-offs you have and what service they are providing?

D. Coates:

Well, we, I assume you wonder how we get into this, do you?

K.A. Childs:

Well, you know, firstly, I would like you to point out how many you have. There seems to be an awful lot in circulation around here.

D. Coates:

We have 22 of these sites through the district of Muskoka. Primarily in contract with the Town of Bracebridge, the Municipality of Gravenhurst and the Township of Muskoka Lakes. We have one Township out of the district which is Humphrey Township and the district of Parry Sound. We are planning an additional 5 sites in the next two months which will put us up to 27 of these sites. They have in most instances, replaced local open burning dumps. The reason behind it was that with the advent of some more stringent regulations from the Environment people, the Townships and Towns were faced with either a) operating those dumps as small sanitary landfill sites which, because of the distances, proved to be uneconomical or b) replacing them. We put the first one into Bracebridge approximately two years ago as an experiment and the business has subsequently expanded. Because of the economics it is much cheaper to haul some quantities of garbage to central landfill sites than it is to try to operate existing open burning dumps or existing dump sites, and to haul fill to cover them, say, two or three times a week in the summer time.

K.A. Childs:

Don, I know you mentioned there in describing the service a number of Townships. Could you give us some idea of the size of the area. I believe you mentioned earlier on that it is roughly 75 miles from North to South. You know, is that the correct figure or how wide is it from East to West? That is a tremendous area it seems.

D. Coates:

Well, Ken, the areas we are covering, when I said 75, I might have been about 10 high. But we are looking at from 65 to 70 mile range North to South and as the crow flies, 35 to 40 in width right now, basically, running parallel to Number 11 highway straight up to the Northwest corner of Muskoka.

K.A. Childs:

I see. And in this area one of the reasons that you mentioned for the operation of landfill sites is that the economics of it are good in terms of providing a service to a fairly small population. How many people does this container service serve on a year round basis, 20,000 to 30,000, or something like this?

D. Coates:

On a year round basis, we took strictly the rural areas that we cover and the one urban area which we cover. You will be looking at roughly 20,000 to 25,000 people on a permanent basis. This would increase in the 50,000 to 60,000 area in the summer time.

K.A. Childs:

These are strictly cottagers coming in for 3 or 4 months of the year and looking for almost an urban service for that period of time. Is that correct?

D. Coates:

Yes and no. Not quite an urban service because they still have to haul their own garbage to a local disposal site. What we have done is to try not to change the patterns too much where people have been accustomed to hauling garbage to a particular site for the last 20 years. We simply replace that site with a transfer station and in some instances, right on the site. In other instances, very near to it. And in some instances, we have taken an area in between two existing dumps and put a site in. So as not to change the pattern of handling they have been used to.

K.A. Childs:

Don, the thing that impressed us when we were driving around here was the relative cleanliness of these sites. There was some littering around and I understand that this is probably due to being the start of the spring season immediately after the winter. But, I imagine there has to be some maintenance of these sites. Who is responsible for that?

D. Coates:

In the contracted municipalities where we have a flat rate yearly contract to handle both the transfer stations and the disposal we are responsible. In the municipalities where we handle the garbage per pick-up basis, if you wish to put it that way, that municipality is responsible to clean them up themselves.

K.A. Childs:

How often would you empty these containers and roll-offs? This must vary throughout the year. I imagine that in the summer months the service is much more frequent.

D. Coates:

Ken, we have sites that in, say, November to February, are running one pick-up a week and in July and August they are running eight pick-ups a week.

K.A. Childs:

This is again just due to that influx of population. I see. This is interesting. It goes 8-fold for collection but the population only goes up 3-fold. Obviously, they must come in here on a Sunday night or Saturday and Sunday are the big days?

D. Coates:

Yes.

K.A. Childs:

Don, we are here at the Gravenhurst landfill site right now, but in these other areas around Bracebridge and up in the Humphrey Township area, do you operate the landfill sites or are the wastes taken to municipally operated disposal sites?

D. Coates:

Humphrey Township, being a small municipality with 4 sites, does not have a disposal location at all. We take care of it for them, and haul it to another location. They are currently being contracted to dump their garbage in Bracebridge. The Bracebridge site is a municipally owned and operated site. In the Muskoka Lakes and Gravenhurst areas we have landfill operation contracts on a 3-year basis with them.

K.A. Childs:

As far as your Company is concerned, you have, I believe, just one conventional packer truck. Do you anticipate expanding into the conventional type of source? Is that the intention of the Company or do you think that this type of operation is so specialized that you just might remain in the containerized business?

D. Coates:

Oh, we are just like everybody else, constantly looking for more work. It is just that the only opportunity for us to bid a contract on a domestic collection unit has only come up once since we started business and we were lucky enough to get it. I can foresee that there would be some more domestic collection contracts coming up and we will quite possibly bid them.

K.A. Childs:

You know we have interests above the municipal area. Do you see that this type of service, the container service, could be utilized in other areas. I am thinking specifically of parks and that type of operation.

D. Coates:

Very definitely.

K.A. Childs:

In the case of a park, you know, Algonquin Park is just up the road a few miles, would you envisage that this type of operation would look for the roll-off or the small box operation? This is off the top sort of thing, but your experience here is so worthwhile.

D. Coates:

Ken, I think you have to look at the generation of refuse in each area. I believe in Algonquin Park the government has a small domestic collection unit which they use to collect cans and garbage. I have not been in that park. I have been to another one which is very near here. The small containers to me, in that type of an operation, work very well. For instance, we run some camp grounds here in the summer time where there might be 150 to 200 camp sites and we spread small containers at strategic locations throughout that camp site on private contracts with camp site operators and they work very, very well for that. The generation of garbage is not sufficient for that man to warrant putting in a roll-off site or anything because people in camp sites want service. They want to be able to walk from their trailer or their tent, you know, no more than 100 feet or something with a little bag of garbage. I think it just really depends on the volume of the delivery service.

K.A. Childs:

So, Don, I want to thank you for taking time out to talk about this service and I think it is a credit both to your Company and to the municipalities in the area that they have obviously taken a major step towards improving the environment of the area. I was vaguely familiar with it in the past, and I know of the number of open dumps that did exist, and what we have seen in the past couple of days certainly is an improvement on that.

Thank you for your time.

D. Coates:

You are most welcome.

CLOSING REMARKS

Mr. L.P. Fedoruk

On behalf of Ray Benoit and myself I'd like to thank the gentlemen from Ottawa - Ted, John, Bob and Chris for coming down and putting most of the material together and presenting this seminar today and yesterday. I think I can speak for Ray, that we are very pleased that there was a good turn out for this one. If you have any questions you can contact Ray or you can contact myself. If we don't have the answers we'll look them up for you. Apart from that I just wish to say thank you for coming and possibly we can put another one on in the future.

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