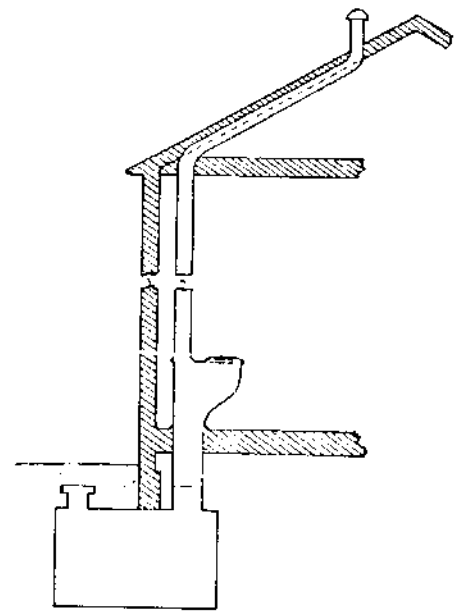
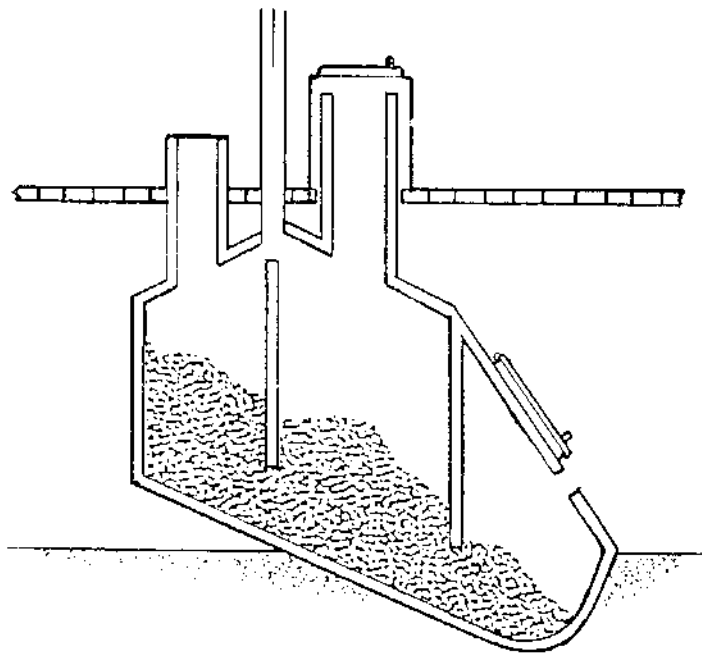


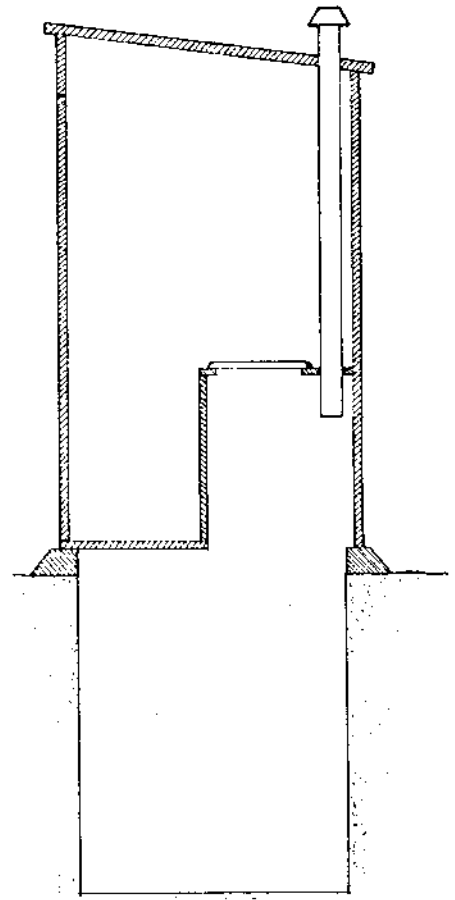
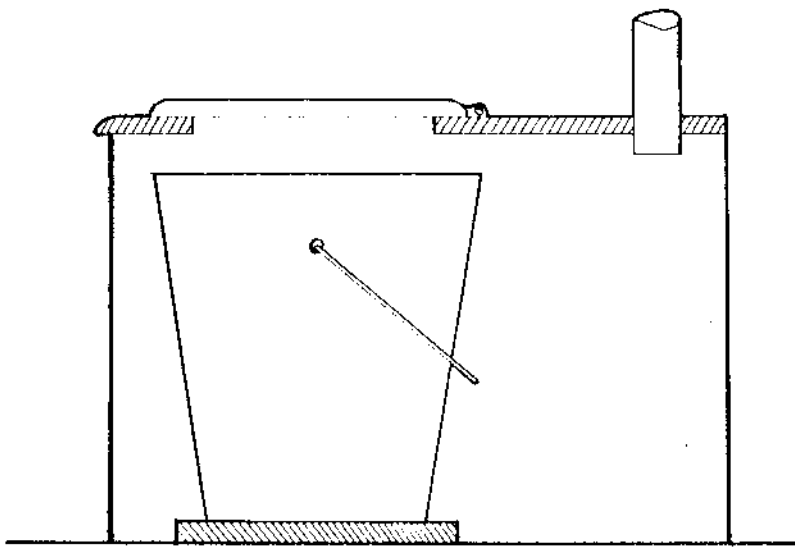
# UNSEWERED TOILETS



Ministry  
of the  
Environment

Hon. George A. Kerr, Q.C.  
Minister

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## FOREWORD

There are about 300,000 cottages in Ontario, occupied generally by well over 1.2 million people for part of the year. One of the main problems all cottagers have in common is that of the disposal of human waste.

Where the toilet facilities can be connected to a municipal sewage system, the solution is obvious. In the majority of cases, however, municipal services are not provided, and the alternative, a good septic tank system, is either expensive or, in many cases, not suitable because of the nature of the terrain.

Ontario regulations, especially Regulation 229/74 under The Environmental Protection Act, 1971, and its amendments, require the approval of all sewage disposal installations, with the exception of systems of Class I. These systems comprise various types of unsewered toilets, known as earth or pit privies, vault privies, removable

pail privies, chemical toilets, incinerating toilets, and composting toilets.

Toilets of Class I are widely used because of their simplicity and their low cost of installation. If properly installed, used, and maintained, they can give good service without damaging the environment.

This booklet provides all the information necessary for proper installation, use, and maintenance of Class I toilet systems. It explains the limitations of the various systems, their advantages and disadvantages, and their possible effect on the environment if they are misused or not properly maintained.

A separate chapter describes in detail the principle, the operation, the advantages and disadvantages, the installation, the use, and the maintenance of the new composting toilets.



## I. INTRODUCTION

The ideal toilet system must reliably dispose of human wastes in a way that neither spreads disease nor offends civilized sensibilities. The standard flush toilet, with its smooth, white surface, self-cleansing flush, water seal against odours, and access to sewers that are someone else's responsibility, is the best choice from the standpoint of health and aesthetics, but it's not always available. It typically runs through three or four gallons of water every time it is flushed. It thus needs an ample supply of water, electricity to run the water pump, and a place to dispose of a lot of wastewater.

Where the standard toilet won't do, you must make other arrangements. As you cast about for alternatives, you will discover human ingenuity at its most diverse: you'll discover privies and chemical toilets, incinerating toilets, variations on the standard flush, indoor compost toilets, and small activated-sludge plants, in fascinating profusion. None of these can be pointed out as the best: all have good points and bad. The "best" choice will depend upon the facilities at your site, the convenience you want, and the money you are willing to spend. In Ontario, it will also be influenced by The Environmental Protection Act.

Sewage is potentially dangerous, even deadly. The microorganisms responsible for many grave diseases—cholera, typhoid fever, hepatitis, and polio, to mention only a few—swarm in the feces of

the sick. If these organisms reach the water supply, hundreds more may sicken. A major concern in the design of any sewage disposal system must be to ensure that the public is at no time exposed to the danger of sewage-borne disease, either indirectly, through their drinking water, or directly, by way of rats, flies, or curious children. For this reason, as well as to safeguard the environment from the unpleasant effects of careless sewage disposal, Ontario law regulates sewage disposal closely.

The disposal methods described in this booklet are not equally acceptable everywhere in Ontario. Local bylaws as well as shallow soil on a steep lot, for instance, may rule out some methods, and sandy soil may favor a system that wouldn't work in clay. To find out which forms of sewage disposal are approved in your area, see the local representative of the Ontario Ministry of the Environment.

Not every toilet unit is a sewage disposal system. A good pit privy is, since the wastes decompose where they fall and enrich their surroundings with no further disturbance, but a modern flush toilet is not. A flush toilet does no more than send the wastes upon their way. In the city, the way leads to the municipal sewage treatment plant, a subject in which we need take no further interest than pleases us. In the country, the owner must choose the destination.





## II. THE SEPTIC TANK SYSTEM

### A. What Does It Do?

Where you can't hook onto the municipal sewers, your best choice in waste disposal is usually a septic tank system, which consists of a septic tank and an underground leaching bed. The big advantage of this system over most of the others is that it will accept all of the household wastewater: the bath water, the dishwater, and the laundry water, as well as what the toilet sends. If treated with reasonable consideration, it will accept all of them without complaint for several years, until it is time to pump the accumulated sludge out of the tank.

Most installations need no machinery, no power, and, apart from pumping out the tank occasionally, no maintenance.

### B. How Does It Work?

The only way to get rid of sewage, as distinguished from merely sending it somewhere else, is to prepare a comfortable home for the microorganisms that eat it. Many strains perform this useful function. For simplicity, they can be divided into two groups: the aerobic ones, which need oxygen, and the anaerobic ones, which can't abide it.

**1. The Tank:** Anaerobic bacteria live and work in the septic tank, which is just that: a tank. It's usually big enough to hold several days' worth of sewage and shaped so that the flow is slow and reasonably uniform. Sewage from the house enters the tank, settles down, gets partly decomposed by the anaerobic bacteria, and flows out of the tank. By this time, if the system is working well, the sewage is a clearish liquid that still stinks and may still carry disease. It should not go anywhere but into the leaching bed or some equivalent treatment facility: by no means directly into a ditch or watercourse.

**2. The Leaching Bed:** A leaching bed consists of one or more rows of buried distribution pipe, each of which is a series of "tiles" laid end-to-end in a bed of crushed stone in a trench. A "tile", in turn, is a length of pipe, typically made of ceramic or plastic. Ceramic tiles are spaced about  $\frac{1}{2}$  inch apart to allow the sewage to flow into the crushed stone. The longer plastic tile is usually perforated by small holes along its length. The

crushed stone acts as a reservoir, from which the sewage can seep slowly into the soil. The dimensions of the trench and the details of how it should be filled in, the characteristics of the soil, the required length of the distribution pipe, and other particulars of the burial are important and are specified under The Environmental Protection Act\*, but they need not concern us further here.

Sewage leaving the septic tank flows down the rows of tiles, leaking continuously into the soil by way of the holes or gaps. In the soil it encounters a flourishing population of aerobic bacteria, who finish the good work begun in the tank by their anaerobic cousins. The

whole subject is decently hidden from view by a fresh, green lawn which rarely needs fertilizer.

### C. Disadvantages?

There are few disadvantages to the septic tank system, apart from its cost — and even that may not compare too badly with the cost of other units, considering that the system handles **all** the household wastes.

Its major drawback is simply that it can't be used everywhere. An impermeable soil, such as clay, won't let the liquid flow through it; a shallow soil hasn't the necessary capacity; and a very cold climate may not suit the indispensable bacteria. Consult your local Environment staff.

\* See the Ministry of the Environment's Booklet **Septic Tank Systems** (Information Services Branch, 135 St. Clair Avenue West, Toronto).

### III. PRIVIES

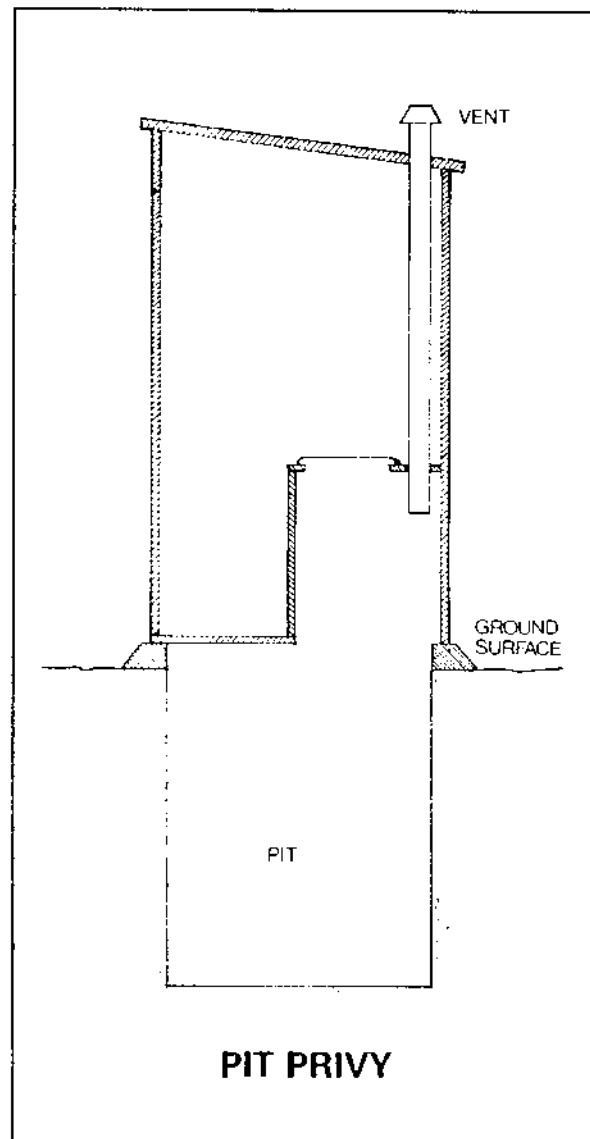
#### A. Pit Privy

1. **Construction:** A pit privy is a hole in the ground, fitted with a seat for comfort and a shed for privacy. It is justly popular for the simplicity of its concept, and it is widely used.

Despite its simplicity, a privy must be planned. To begin with, the pit should be big enough to last a while — at least five years, say, before it fills up and you have to dig a new one. For year-round family use in well-drained soil, estimate two cubic feet per person per year, but bear in mind that this figure may not apply to camping conventions or busy resorts, where the pit may fill too fast for normal drainage and decomposition. Build the shed stoutly, include a window, and put screens where they're needed, to keep out flies, rodents, and other carriers of filth. Porcupines show little interest in the pit but may eat the privy, and where they abound metal sheathing on the outside walls may help.

Don't neglect to vent the pit — not the shed, but the pit — and vent it well. Fresh air and foul will balance themselves some-

how, and you will be happier in your work if they do so through a good-sized vent pipe, rather than by way of the seat. A screen



on the top of the vent pipe will discourage flies, and a little raised roof (not a lid) will keep out the rain. The Ministry of the Environment supplies a working drawing on request.

Well-vented and considerably used, a privy is reasonably inoffensive; but a light sprinkling with chloride of lime every couple of days, or a nodding acquaintance with commercial privy deodorants, will help to keep it habitable.

While hunting for your spade, consider the soil in which the pit will be dug. There must be enough of it to surround the pit with two feet of earth in all directions, around it as well as below it, and it must have the right composition. If it's too sandy, the walls of the pit will have to be shored to prevent cave-ins. If it's solid clay, the liquids will just sit there, perpetually with you; you might as well use a holding tank to begin with, and have it pumped out when it's full. (But ask the Environment office about any local restrictions on holding tanks.)

Ideally, the soil should be porous enough to permit liquid to seep through it, tight enough to keep liquids from running through too fast, and deep enough to shield the groundwater from pollution. It should also slope away from the hole on all sides: do not dig your pit in the centre of a drainage basin, and build a low mound around it to keep out rainwater runoff.

(The "groundwater", incidentally, is the water which saturates the ground beneath the surface, the water which feeds springs and is tapped by wells. The "water table" is the tap level of the groundwater.)

When checking the water table, to be sure you stop digging the pit two feet above it, remember that it varies during the year; it's higher in wet weather and lower in droughts. Check the level shortly after the spring thaw.

A final safety note: don't let a little child use the privy unattended, especially if there's no child-size hole. Occasionally an unfortunate youngster falls in.

**2. Pro and Con:** A good privy is safe, and it does the complete job as far as toilet wastes are concerned. You may have to dig a new hole now and then, but you don't have to clean out the old one as, in effect, you may have to do with more elegant systems. It also is cheap.

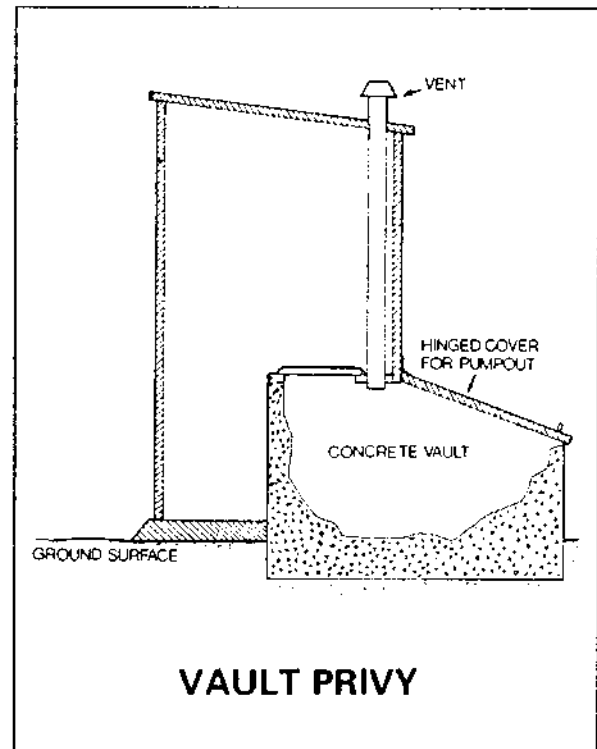
On the negative side, the privy is, for reasons of health, located at a distance from the house. This point gains in importance after dark or in winter. In some northern areas health officers frown on privies because their users fail to bundle up: the absence of warm clothing can be as unhealthy as its presence is inconvenient. A chamber-pot emptied periodically into the privy solves one problem by introducing a worse one: the presence of a thoroughly unaesthe-

tic and potentially dangerous pot of human wastes in the house.

### B. Pail and Vault Privies

Variations on the privy theme include the pail privy and the vault privy. These differ from the self-contained pit privy in that neither of them ultimately gets rid of the wastes. They merely collect them and postpone the problem for a while. The pail privy substitutes a pail for the pit, while the vault privy uses a small holding tank, the "vault". (The latter, in lightweight plastic, is often encountered at construction sites and club-houses.) The pail must be taken away from time to time and dumped, probably by you; and the vault must be pumped out and the contents taken away and dumped, probably by a contractor but at your expense.

The contractor will need a dumping permit from the Ministry of the Environment. You need no permit to bury your pailful on your own property, but you are obliged to make certain it causes no pollution and creates no public health nuisance. After a while, if you begin to get tired of the squashy places



in your woods, you may wish to consider a cesspool. A cesspool is basically the pit of a pit privy, with a lid instead of a shed. It must meet all the design requirements of the privy pit, and it requires a permit. Unless suitable soil is a long walk from the house, you'll be better off with the pit privy.

If you opt for one of these, the vault is the better choice. The pail is cheaper, but you may not enjoy carrying it. Besides, it's a health hazard.

## IV. CHEMICAL TOILETS

### A The Basic Chemistry

The simplest chemical toilet is a bucket with a seat. The "chemical" part is a small amount of solution poured into the bucket before use. It can act in one of three ways: as a caustic, as a preservative, or as a dye. Accordingly, it may decompose the wastes, preserve them, or merely improve their appearance.

The first two kinds of chemicals make the wastes harmless. The caustic, usually caustic soda or lye, liquifies and partly decomposes the wastes, at the same time killing any bacteria present and destroying the eggs of parasites, a significant feature in controlling the spread of disease. A chemical preservative such as formaldehyde also destroys any bacteria present; however, it then prevents the wastes from decomposing: it kills the bacteria which would otherwise bring about biological decomposition, but lacks the chemical decomposing power of the caustic.

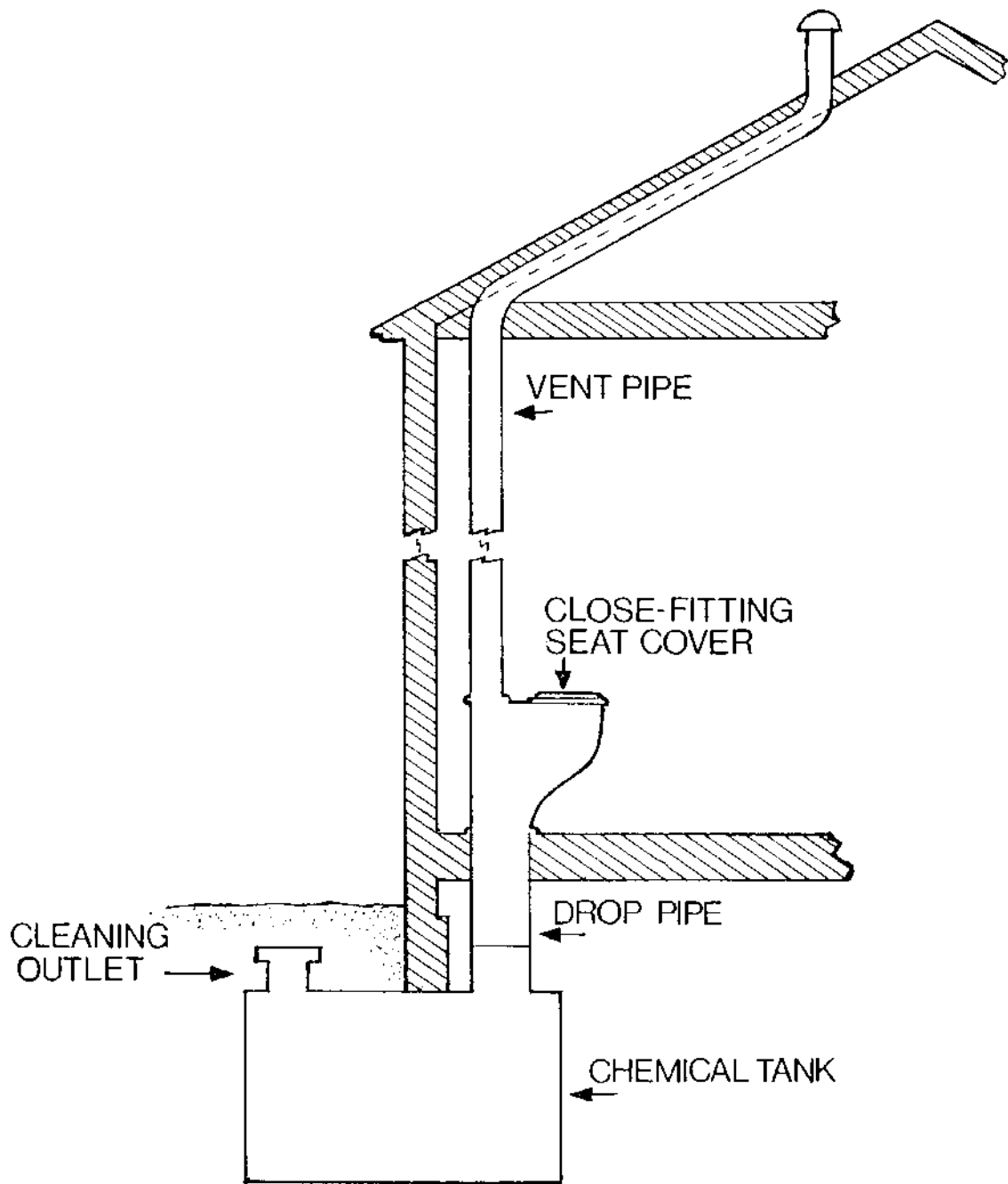
Killing bacteria present reduces the odours typical of the wash-room. To further the good work, many chemical charges also contain a perfume, and possibly

a blue or green dye to mask the yellow-brown colour imparted by nature. As an additional advantage, killing the bacteria means that a chemical toilet using either a caustic or a preservative may safely be located in the house. The whole situation begins to seem more like home.

If the chemical charge consists of only dye and perfume, and lacks either kind of bactericide, the improvement in appearance is deceptive. If a bactericide is not present, the bacteria are not killed; this kind of toilet is a pail privy with interior decoration. It is no more appropriate in the house than any other privy would be.

### B. Pro and Con

The chief disadvantage of the chemical toilet is that, like the pail and vault privies, it does not solve the problem; it merely gives you time to think about it. Using a chemical disinfectant is also a coin with two sides. The same chemical that so conveniently inhibits decomposition during use continues to inhibit it afterwards; and getting rid of the wastes, you recall, must ultimately take place through bacterial decomposition. For this reason, buried wastes are likely



**CHEMICAL TOILET  
— DROP TYPE**

to hang around far longer than one would wish, and wastes pumped into a septic tank are likely to stop the operation of the entire system. If you dump them into a lake, so as to dilute the preservative, you will succeed; the result is equivalent to using a chamber pot in the first place and emptying it overboard.

A solution which Environment officials will sometimes approve, especially where people are few and the high water table is low, is a cesspool. In crowded vacation spots, where the soil is thin and the water table high, you might as well build a privy on the end of your dock, for all the pollution a cesspool will spare your lake. (Perhaps it should be mentioned without delay that a privy on the end of dock is not an approved method of sewage disposal.)

The best solution to the problem may be to discharge the chemical wastes to a municipal sewage plant, provided the plant is big and the chemical toilets few. A big plant, with other contributions pouring in, can dilute the chemical mix to the equivalent of raw sewage and then treat it along with the rest. If too many people get the same idea, however, the chemicals could stop the bacterial action of the whole sewage works, with implications one might prefer not to pursue.

### C. Variations

**1. Bucket:** The most basic version of the chemical toilet is a simple bucket, nowadays often

fitted with a removable plastic liner, placed in a small, vented, metal cabinet in the bathroom. The approach is simple, and the unit is odourless when properly installed and operated. On the debit side, the contents of the bucket are open to view at all times, which is generally not very pleasing. Furthermore, when the bucket is more than half full, there is likely to be a splash on the user: the water is cold, the preservative may contain caustic, which burns, and the dye can stain clothing.

And then there is the problem of the full bags. They must be removed at the proper time, and their capacity is limited. If their owner gives a party, for instance, they may not last the evening. They must be taken to an approved dumping place, and they must be treated until arrival there with sufficient respect to prevent a puncture.

### **2. Improvements: Splash Pan and Drop Pipe:**

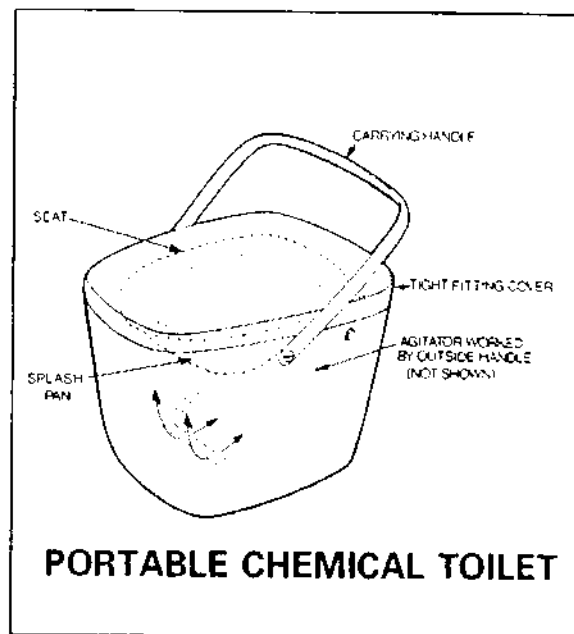
Other models of the chemical toilet offer various degrees of refinement to the basic concept. A splash pan is available, shaped like the bowl of the standard flush toilet, which prevents all but a rare splash on the user. To allow room for the splash pan, though, the bucket containing the charge becomes a small tank, the plastic bag is no longer used, and the contents of the tank must be drained at intervals to a suitable point of disposal. The installation is subject to all the local restrictions on holding tanks.



Another version locates the toilet over a tank buried in the ground beneath the house. The connection is usually made by a drop pipe, and the drop is usually sufficient to eliminate the need for a splash pan. The tank must be pumped out at suitable intervals, and the contents disposed of according to local custom.

**3. Recirculating:** The recirculating chemical toilet is much like the splash-pan toilet, except that it uses the contents of the tank to flush the bowl. The contents are liquified and dyed blue by the chemical charge, the construction quite eliminates splashing, and the unit is aesthetically much like the standard flush toilet (This is the familiar toilet of the airplane washroom). The need for a recirculating pump, however, increases the cost of this unit; it also limits its use to areas where electricity is available. The chief disadvantage of this model is that it cannot be used if the electricity fails or the pump breaks down.

**4. Portable:** A useful final variant on the chemical toilet is the portable model. This is much like the basic bucket model, though it may have a splash pan, and is fitted with a fairly tight lid and a carrying handle. It must be



carried with some care to avoid splashing or spilling. Its capacity is, of course, limited by the need for portability, and the usual requirement for safe disposal of the contents remains. These units may be drained into a standard toilet and flushed to municipal sewers, but not to a private septic tank.

Incidentally, while looking at portable toilets, consider weight and stability. By the time it's ready for emptying, the toilet may weigh 70 to 80 pounds; for many people, that's a lot to lift. Also, some models are tippy, and may need a frame for convenient use by children or older people.

## V. INCINERATING TOILETS

This unit consists of a toilet bowl above a small incinerating tank. In the tank, which may be heated by either gas or electricity, the wastes are burned to a dry, sterile ash which may be discarded with no special precautions.

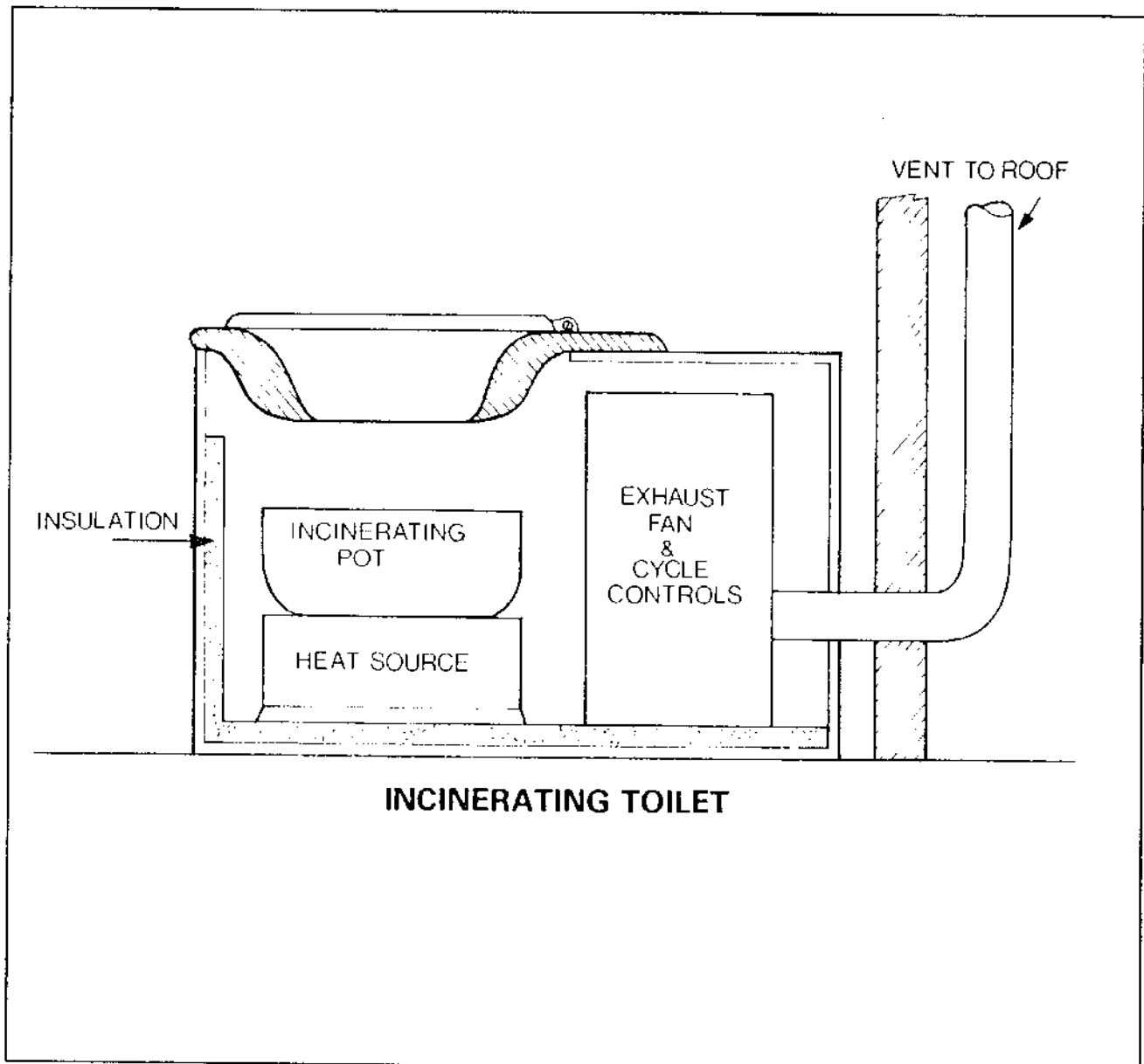
The toilet is thus a self-contained unit requiring no further equipment for disposing of the wastes committed to its keeping. Unfortunately, the approach, excellent in concept, may have certain drawbacks in practice. Consider some of these points as you compare models.

1. Toilet wastes are chiefly composed of water. Consequently, before they can be burned, they must be dried. The drying process is one of boiling; and this, as well as the actual burning, creates a notable stench. Good design, including high combustion temperatures, can give you an odourless gas, but these temperatures may not be reached in small, household units. If the neighbours complain, the unit can be closed
2. The toilet, naturally, grows hot during the incinerating cycle, and requires time to cool. In some models, the seat grows hot, too, and the cooling period may be as long as 40 minutes. The possible inconvenience of this delay is obvious, as is the peril of trying to reduce it.
3. Some models are designed so that the seat does not heat up during the combustion cycle, and the cycle itself can be interrupted at any time for further use, a far more practical arrangement. Too many interruptions, however, can lead to trouble, as the incinerating tank is usually small. If it is not emptied by a complete combustion cycle after two or three uses, it may overflow. The only remedy then is to spoon out the contents down to the "fire line" (saving

them, of course, for future cycles), and start over.

4. The incinerator unit, the necessary insulation, and the stack to lead combustion products away, all add up to an expensive installation. In addition, whether the incinerator uses propane gas or electricity, the operating costs can be high.

5. The high-salt liquid which develops during incineration tends to corrode valves and other moving parts. Further, though some models reduce the wastes to a light ash which can easily be vacuumed out or dumped, others have been known to reduce them to a clinker which can only be removed with a hammer.



## VI. COMPOSTING TOILETS

### A. Introduction

**1. What Composting Is:** A comparative newcomer to North America, the composting toilet has been available for some years in Scandinavia. Its principle is simple. Like the compost heap in the garden or the manure pile beside the barn, the composting toilet allows organic materials to decompose in the presence of air to an inoffensive material much esteemed as fertilizer.

The results differ significantly from what happens in the pit of a pit privy. The packed mass in a pit privy is airless except at its surface. Most of it must, therefore, decompose anaerobically, like the material in a septic tank. The products of anaerobic decomposition are such gases as hydrogen sulphide and methane. The former is the gas which gives the characteristic odour to eggs rotting anaerobically in their shells; the latter, "marsh gas", bubbles up from the bottom of stagnant lakes where dead plants rot.

A compost heap is kept loose by the grass cuttings, twigs, and leaves of which it is composed,

and its interior is always in contact with air. The same is true of a manure pile, where the straw of the animals' bedding keeps other residues from packing too closely. The result of this happy state of affairs is aerobic decomposition, which produces carbon dioxide and water vapour, both odourless. The difference between the two processes in nature is illustrated by the difference between leaf-mould on the well-aerated forest floor and swamp-muck.

The composting toilet attempts to introduce aerobic decomposition to the disposal of human wastes in reasonably pleasant circumstances. Different models achieve different degrees of success. These are described below.

Three topics are relevant to all composting toilets: the effect of temperature, the breeding of flies, and the safety of the final compost.

### 2. Low Temperature, Flies, and the Vegetable Garden

**a Composting May Stop in Winter:** Like most microor-

ganisms, those which cause aerobic decomposition work best when they are comfortably warm. They slow down as they cool and become dormant at low temperatures. A composting tank kept outdoors or in an unheated basement cannot be expected to operate well in winter. The chilled bacteria wait for spring, and the tank serves primarily as a holding tank. If the winter is short and the summer is hot, and if your unit is sized to allow for these fluctuations, all may be well.

- b Flies Thrive in Compost:** The warmth and nutrients in composting manure make it ideal for raising fly larvae; similarly, flies prosper in the tank of a composting toilet.

The mild down-draft at the toilet and garbage chute may or may not be enough to contain the swelling population. A well-designed vent pipe comes complete with a fine-mesh fly-screen which will probably prevent these insects from entering the tank by this route, but there are other ways.

Because the well-being of the bacteria in the composting mass is so important, you cannot attack the flies with disinfectants or chloride of lime left over from your privy days. Fortunately, however, biodegradable insecticides are available from the manufacturers of some of the

composting toilets. When applied as directed (sparingly), these will kill both flies and larvae, without interfering with the essential bacteria.

- c Is Compost Safe?** As every gardener knows, compost made of dead leaves, lawn cuttings, twigs, and vegetable scraps supplies excellent natural enrichment when dug well into the soil. Manure and human wastes have long been used for the same purpose and in some places still are. Unfortunately, however, bacteria and viruses responsible for many serious human diseases pass out of the body with the faeces. Should these microorganisms enter another person's body, that person may fall gravely ill. One of the commonest modes of entry is through food prepared by unwashed hands, or on which a contaminated fly may have walked.

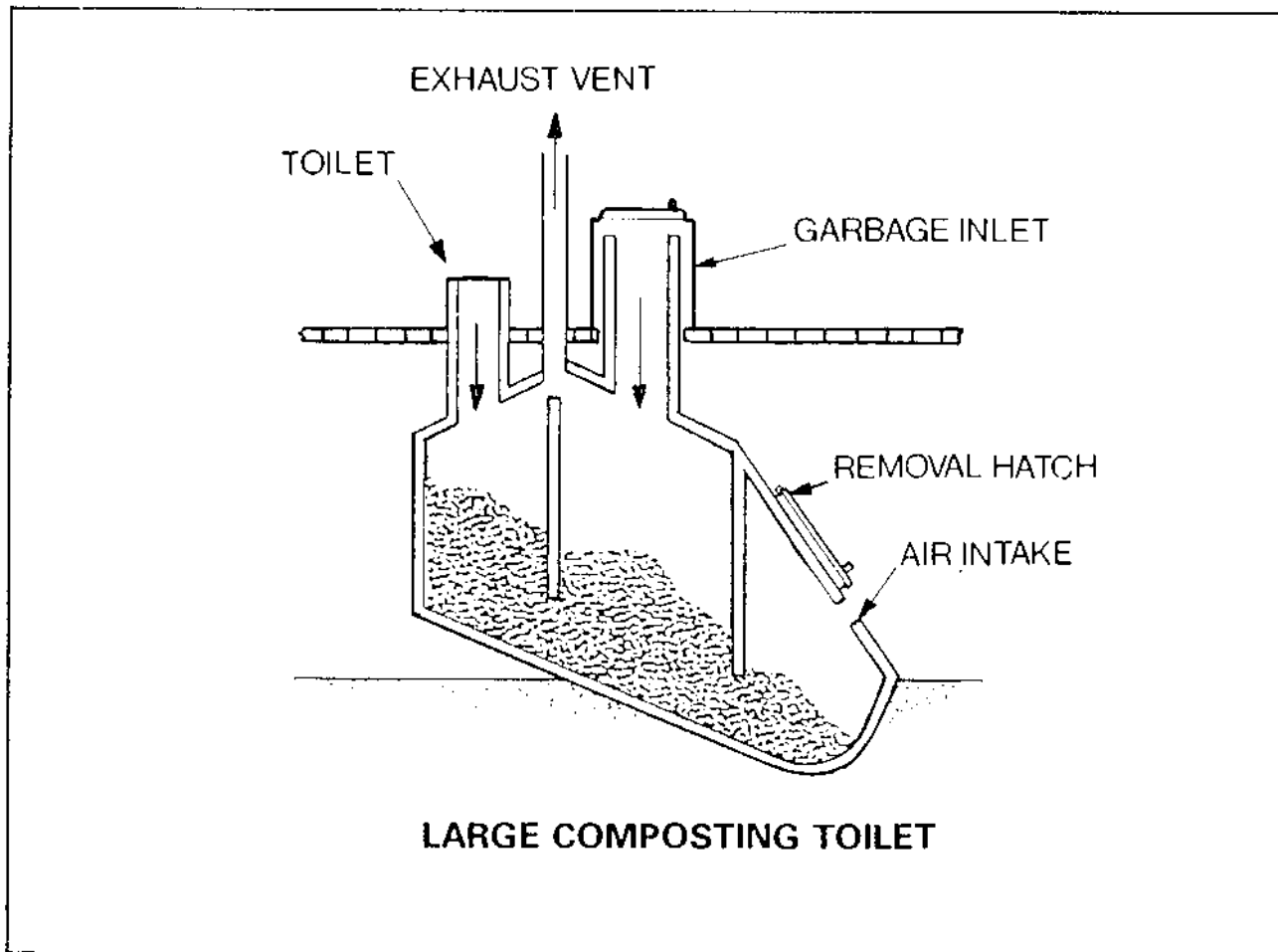
Most of the microorganisms which cause disease cannot live under conditions very different from those found in the human body. In a compost heap they will die from the lower temperatures, the drier conditions, and the competition of the natural (and harmless) bacteria of the soil. Compost which has spent enough time in a composting toilet will usually contain only the microorganisms commonly found in garden soil.

If the residence time was too short or if all was not well within the toilet, matters may be different. The makers of composting toilets generally recommend using the unit's product freely to nourish shrubs and flowers. They recommend it for vegetables, too, but suggest not bringing it directly into contact with that part of the vegetable which you intend to eat. Possibly you should use some other fertilizer around the roots of root vegetables or in the soil through which the leaves of salad vegetables must push their way before you pick them.

## B. Large and Small Units

Composting toilets can be divided into two major groups: large units and small ones. The first put the composting tank in the basement, because it is too big to fit in the bathroom. (Some of these tanks are, in fact, bigger than some bathrooms: one of them measures about seven or eight feet high by nine feet long by four feet wide.) In the smaller units, the toilet and a small compost box form a single unit, which can be installed readily in most bathrooms.

The large units are expensive: up to \$1,500 - 2,000 installed.



Small ones cost considerably less, about \$600 - 700 (in 1976).

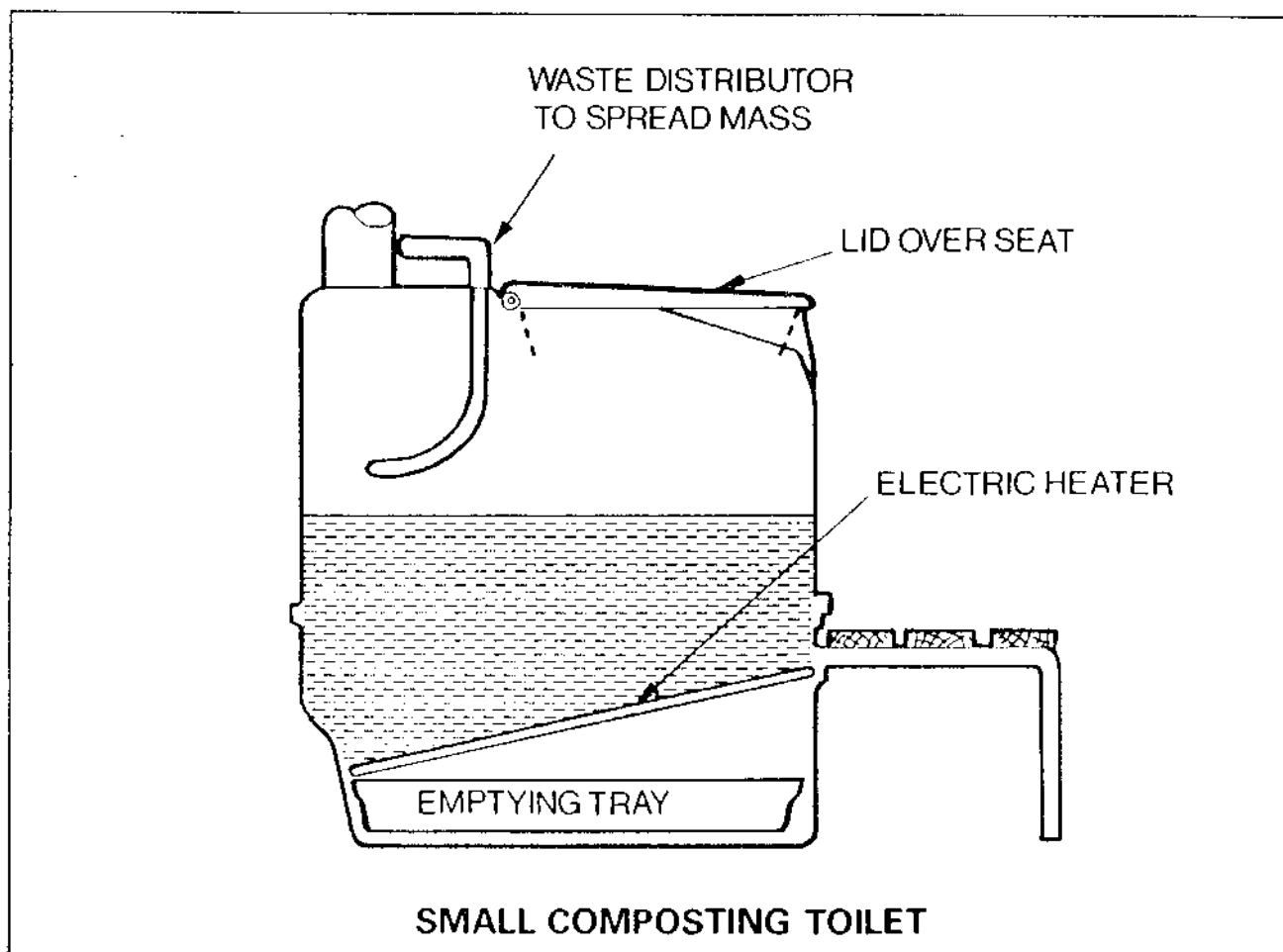
### 1. Large Units

a. **The Design Principles:** The toilet of a large unit is pleasantly indoors, in the bathroom of the house. It is connected by a drop pipe to the tank directly below, in the basement. If the house (or cottage) does not have a basement, particularly if the house is also built upon thin soil, you have a problem. Some units provide a screw-type conveyor to move the wastes from their point of deposition to a composting tank located outdoors, but this introduces a complex

piece of electrically driven machinery, and much of the simplicity of the concept is lost. The lower ambient temperatures outdoors may also affect the composting.

The drop pipe from the toilet has to have a large diameter to avoid fouling in use and must, therefore, pass through a large hole in the bathroom floor. But the distance from the toilet down to the tank's interior, which is not illuminated, essentially removes the contents of the tank from view.

Odour is eliminated, in principle, by an insulated vent pipe connecting the interior of the tank



with the out-of-doors. When all goes well, this vent is not merely a passive conduit, but a chimney. The composting material in the tank is warm, as are the water vapor and carbon dioxide rising from it. As warm air rises, the column of warm gases in the vent pipe flows out the top of the pipe.

This creates a partial vacuum within the composting tank. This partial vacuum draws replacement air into the tank from two sources: an air intake designed to flow air through the wastes and keep them aerobic, and the toilet seat when the lid is up. The slight downdraft through the toilet seat prevents odours from reaching the bathroom.

**b. The Problems:** So much for theory. With some units practice may be different. A unit which consists of a simple tank accepting only toilet wastes, for instance, resembles the pit of a privy. The packed wastes admit no air and eventually form a dry crust of aerobically decomposed material covering a liquid mass slowly decomposing anaerobically. The owner of such a tank is advised to stir the contents frequently, with a paddle of some sort. Not all owners will relish the task.

Some units attempt to overcome this unpleasantness by mounting the tank at a slight angle to the floor: 20° to 30° or

so. The wastes are supposed to slide slowly down the slope, composting as they go. They are supposed to reach the retrieval door at the bottom in a fit condition to be shoveled out without distressing the shoveler.

Of the units that fail, some permit the interior mass to slide too quickly, so that it reaches the exit while still too near its original state. Others that fail manage to hold back the mass by means of baffles but cannot prevent the somewhat muddy urine which drains from the mass from forming a puddle at the exit door.

**c. Garbage Disposal, Too?** The problem with the above units is aeration—or, rather, the lack of aeration. Toilet wastes alone, even if mixed with toilet paper, tend to pack so tightly that it is very difficult to pass air through the mass. To overcome this difficulty some units use special aerating pipes. Others follow more closely the principles of the compost heap by accepting some of the household garbage in addition to the toilet wastes. Such units will digest basically organic food scraps: meat scraps, bones, and grease, as well as vegetable scraps and parings.

They will also accept a fair amount of cellulose in some of its familiar household forms: paper towels, kleenex and toilet paper of course, sanitary nap-



kins and disposable diapers (minus the plastic part), and even floor sweepings and the contents of the vacuum cleaner bag.\*

Like the straw in the manure pile, this vegetable material prevents the mass in the compost tank from packing too closely to admit air. In addition, the paper and the compost, when true compost begins to form, are dryish and absorb the urine. The latter, retained in a warm, open medium through which air is flowing, soon evaporates. More precisely, the water content evaporates while the salt content remains behind as nitrogen compounds for the eventual benefit of the owner's garden.

**d. Orientation and Quiet Days:**

A unit which accepts the household garbage and other cellulosic materials along with the toilet wastes tends to work considerably better than one which accepts only toilet wastes, but nothing is perfect. To begin with, since garbage and toilet wastes have to enter the same subterranean tank, the kitchen and the bathroom have to be

adjacent — the house may have to be designed around the disposal unit. A large unit also takes a long time to reach its steady-state condition, in which the nearly full tank continuously accepts wastes and emits a continuous supply of compost. Filling the tank takes longer than one might expect, as nearly 90% of the original volume goes up the vent in the form of gases. For the first couple of years, while the tank is filling, there may be too little compost to hold back liquids until they evaporate. A few sacks of peat moss judiciously applied will help. Indeed, they may solve the problem; but the unit cannot be ignored during its first years.

Finally, the venting system may be vulnerable to hot weather. On a hot day, when the surrounding air is as warm as the air in the pipe, the column in the vent pipe will not rise and the odour of the uncomposted contents of the tank may seep throughout the house. A small exhaust fan greatly reduces the likelihood of this distressing occurrence. Purists will point out that installing a fan in a unit which prides itself upon avoiding all artificial contrivances makes the whole process less natural, but others may be willing to compromise.

**2. Small Units:** The smaller composting toilets consist essentially of a box with a comfortable seat on top. The size of the box varies but it will fit into most bathrooms. No hole in the floor is needed, but a two-inch to

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\* NOTE: Ontario regulations permit the addition of small quantities of vegetable matter only to composting systems, specifically designed for the biological decomposition of such waste or that require small quantities of vegetable matter to improve the decomposition of human body waste. See also the excerpts from the revisions to Ontario Regulation 229/74 applicable to private sewage systems under Part VII of The Environmental Protection Act, 1971, reprinted in the Appendix.

four-inch vent-pipe must be led out-of-doors.

**a. No Longer Wholly Natural:** Composting depends on the activity of a multitude of microorganisms. It is not a chemical or mechanical process which can proceed at any speed convenient to the user. The little box of the smaller units demands some concessions to biology.

The first of these is that the smaller composting mass can no longer be left to find its own operating temperature. The contents of a small unit must be heated to tropical temperatures.

The heater is commonly a small, low-temperature electric resistance unit fitted at the bottom of the composting wastes. This makes the small composting toilet unsuitable for a cottage lacking electricity. In addition, a small fan in the vent pipe is also essential, both to draw air through the contents and to prevent odours from emerging when the lid over the seat is raised. The unit will not consume much power, but some it must have.

**b. Removing the Compost:** In due course, the matured compost must be removed from the toilet. This task should not be necessary more often than every six months to a year. In most units, the contents of the box rest above the heater. At the proper time, the owner, using some mechanical device sup-

plied with the unit, disturbs the bottom layers so that the material drops through the heater into a collecting bin, which can be removed and emptied. This chore should be neither unpleasant nor frequent in a unit operating as it should, but the nature of the mechanical device deserves some study before the unit is chosen. Does it seem sturdy? Is using it according to instructions likely to be a disagreeable task? Is the full bin likely to be heavy? Can the bin be removed easily and without conspicuous danger of spilling its contents?

**c. Achieving Aeration:** Because of their size, small units are designed to accept only toilet wastes. Here many of them encounter the same problem as their larger counterparts; the wet and close-packed wastes resist all efforts to draw air through them and set up their own unsavoury anaerobic system. If the urine can drain away or evaporate quickly, the solid residue can set into a firm block.

Several units come with an internal device for stirring (and thus aerating) the mass, usually operated by a handle projecting outside the unit. Unfortunately, the stirrers supplied tend to be no match for the dry mass. The handles may break off, and the interior parts may remain immovably imbedded. Since what they are imbedded in is not compost, this situation may not be very satisfactory.

The manufacturers of some units recommend adding some cellulose to keep the mass open enough to be aerated. Their units welcome toilet paper, kleenex, and vegetable scraps and trimmings, but not many: as small units they can spare only so much volume. And meat trimmings, cooking liquids, and grease are out. These act to dampen and compact the mass, rather than aerate it. In effect, the smaller composting toilets are toilets only. Some may accept and profit from the kitchen's vegetable scraps, but none can be used for complete garbage disposal.

**d. Design, Aesthetics, Flies, and Parties:** Most of the considerations affecting the purchase of a small composting toilet centre around the size of the composting box.

To begin with, the smaller the box, the more certain you may wish to be that complete composting will occur within a short time. Temperature and good aeration matter here.

To make the most of their small size, most small composting toilets reach their steady state when nearly full. Some manufacturers supply a distributor for evening matters out, lest the user's work rise to meet him. As a result, the contents do not rest in a dim void eight feet or so below the bathroom, but are offered prominently to view whenever the toilet lid is raised. One manufacturer suggests

sprucing things up when necessary by strewing a few handfuls of grass cuttings over the surface.

Small units, like large ones, can become infested with flies. These insects can be dealt with by the biodegradable insecticides recommended by the manufacturers.

Basic to the small size of the small units is the fact that they cannot cope readily with fluctuations in use — a party, for example. Solids introduced into the toilet remain on top of what they find; liquids seep into the mass. A little liquid in a full toilet evaporates fast. A lot of liquid may penetrate the mass completely and drip through the bottom into the collecting bin.

During a well attended celebration the collecting bin may fill and even overflow. The owner surprised by these consequences of social success can do little more than get out the mop.

### **C. Summary: Composting May Be Right For You**

The small composting toilet is not the only unsewered toilet unable to handle unexpectedly heavy loads. The bucket and chemical toilets are also sharply limited by their size, the incinerating toilet must empty itself regularly, and even a privy has only a limited capacity. A major advantage of the composting toilet — if it is working as intended — is that it reduces the volume of the wastes it receives

— in due time — to about a tenth of their original volume and delivers that final tenth in a form that is not disagreeable to handle (even literally). The cottage owner who is not a gardener can dispose of his compost by simply burying it, without concern over chemicals or excessive liquid content.

The main disadvantage to this type of toilet is that a biological system is not a mechanical contrivance and cannot be treated mechanically. A composting toilet works because a population of healthy microorganisms prospers under choice conditions of warmth and moisture. A householder concerned about his own comfort must be ever mindful of theirs.

An aeration unit is not a machine. It is a balanced ecological system, the home of living beings, which depend for their well-being and effective function on correct temperature, proper air flow, good mixing, and all the other variables which govern life and health. If one of these fails, the aerobic bacteria may die off. Their place may

then be taken by anaerobic bacteria, bacteria which function without air. The sewage then turns "septic", putrefies, and stinks. This sorry situation could result if the aeration unit were shut off: if the cottager wished to go home after the weekend, for instance, or the year-round occupant to take a holiday, or if the pump broke down in some idyllic spot far from the nearest spare-parts depot. These units are not approved unless the owner has a written servicing agreement, either with the manufacturer or with a person licensed by the Ministry of the Environment to service them.

Some aeration units, particularly where water is scarce, economize by using the aerated wastewater to flush the bowl. The principle is that of the recirculating chemical toilet, but the results differ. The flush-water is not a cheerful blue, but an unappealing natural brown, and it may not be odourless. Unless aeration has completed the job of decomposition, what recirculates is merely what went in, homogenized.

## VII. SOME OF THE OTHERS

### A. Septic Toilet

The septic toilet is a toilet seat above a buried tank. Wastes fall directly into this tank through a drop pipe, followed once a day by a pailful of water. Since the tank is always full, a pailful of wastes is displaced by the water and flows out of the tank into an adjacent leaching bed or cess-pool. This arrangement recalls the standard septic tank system, but there are some important differences.

1. The septic tank system disposes of all the household wastewater, while the septic toilet handles only toilet wastes.

2. The septic tank system is usually associated with a flush toilet and other standard bathroom fixtures. The septic toilet is a bucket privy with a drop pipe. The contents of the tank are in view; the inner wall of the drop pipe can become fouled and require cleaning; the bottom end of the drop pipe, if it reaches below the water surface in the tank, can become plugged with what floats; and the pipe itself is a first-rate conduit for odours.

In spite of this, the septic privy is a great improvement over the bucket toilet. Its leaching bed **does** ultimately dispose of the wastes; you don't have to take them somewhere else to get rid of them.

3. The leaching bed of a septic toilet is often very small compared with that of the septic tank system, because the volume of the wastes is smaller. The organic load from the toilet, however, is not changed by the design of the toilet or the volume of transport water. A relatively heavy organic load can clog the soil of the leaching bed, preventing effective operation. These leaching beds are subject to many of the same controls as those of septic tank systems. Ask the local Environment office before you dig.

### B. Low-Volume (Minimum-Flush) Toilets

In a sense, these systems are a half-way house between the septic toilet and the septic tank system. The toilet itself closely resembles the standard flush

toilet, except for the reduction in water use. Where the standard toilet typically requires three to four gallons per flush, the low-volume toilet uses an economical one to two quarts.

The fixed model is mounted over a buried septic tank, which drains in the usual way to a buried leaching bed. The toilet is connected to the tank by a drop pipe, which normally extends below the level of the septic tank liquid — so far, much like the septic toilet. To avoid odour, some models are designed with a water seal: a spring-loaded plate presses upward against a gasket and retains a portion of the clean flush-water after each use. A foot-pedal tilts the plate down after use, permitting wastes and flush-water to drop into the septic tank. As an additional advantage, in areas lacking pumped water, the unit can be flushed manually by pouring a quart or so of water into the bowl.

The disadvantages tend to centre around the seal. A bit of toilet paper can prevent the plate from seating properly, so that the water seal is lost, and with it the odour protection. Repeated use can distort the plate or gasket slightly, with the same result. And don't let your foot slip off the pedal controlling that spring-loaded plate. The plate has been known to snap back into place with such vigour that the contents hit the ceiling.

The leaching bed for the minimum-flush system, like that for the septic toilet, is often shorter than it should be for the organic loading. If the legal requirements point to a longer leaching bed, you may want to consider sizing it to take care of the rest of the wastewater, too. In effect, you might be well off to consider a standard septic tank system with a water-saving minimum-flush toilet. Check your soil and the local prices, as well as the local Environment requirements, before you decide.

### **C. Portable Low-Volume Toilets**

This convenient unit has a sealed top to prevent spilling or splashing while carrying. Otherwise, like the portable chemical toilet, it is a small tank surmounted by a seat.

A hand pump flushes the unit after use, and there is a water seal against odours. These units can be emptied into any fixed flush toilet, whether it is connected to sewers or to a septic tank: since no bactericidal chemicals are present, the contents will not affect the bacterial operation of the septic tank. Consider, however, the stability and the full weight of the unit. The absence of bactericidal chemicals also means that the contents may be a health hazard. Handle the unit like a privy pail, with care.

#### **D. Continuous Aeration Systems**

This waste-treatment method, usually an expensive one, features an aerated tank, and can accept all of the household wastewater, not just the toilet wastes. The system is in effect a small activated sludge plant, similar to the secondary treatment plant of many municipal sewage works: air, vigorously stirred or bubbled into the wastes, nourishes aerobic bacteria, which break down the complex organic compounds of the wastes into simpler, inoffensive ones. The products of their labour are a reasonably clear liquid and a sludge. The liquid is

usually discharged to a leaching bed or to a watercourse — both alternatives require approvals — while the sludge, like the sludge from a septic tank, must be pumped out periodically and disposed of as the law permits.

Though an effective treatment method, an aeration plant is usually better suited to towns or small communities than to individual use. For one thing, such a unit needs electricity to run the aeration pump; but even where electricity is available, operating the plant can offer the novice disagreeable surprises.

For the reader's convenience in comparing the toilet systems described in this booklet, the position of the toilet in relation to other structures is listed in Tables 4 and 5, as shown in the regulations.

## APPENDIX I

### EXTRACT FROM THE REGULATION TO AMEND ONTARIO REGULATION 229/74 MADE UNDER THE ENVIRONMENTAL PROTECTION ACT, 1971

1. Clause a of section 2 of Ontario Regulation 229/74 is revoked and the following substituted therefor:

- (a) Class 1— a chemical toilet, an incinerating toilet, a recirculating toilet and all forms of privy including an earth pit privy, a pail privy, a privy vault and a composting toilet system;

2. Section 7 of the said Regulation, as amended by section 2 of Ontario Regulation 944/74 and section 1 of Ontario Regulation 956/75, is revoked and the following substituted therefor:

7.- (1) The following are prescribed as standards for the construction of any tank used in a sewage system for collecting, holding or storing sewage, whether or not it is part of a Class 5 sewage system, or used for treating sewage:

- (a) the tank shall be constructed of concrete, steel, fibreglass, reinforced plastic or such other material as may be approved by the Minister;
- (b) the tank installed, assembled or constructed shall,
  - (i) be carefully made, exhibit craftsmanship and true quality, be sound, durable and thoroughly capable of satisfactory and troublefree service,
  - (ii) have such wall thickness, reinforcing and strength as is necessary to meet the requirements of use in service and any stresses to which it may be subjected prior to or during installation, and
  - (iii) be of watertight construction;



- (c) materials used in the construction of the tank shall be in conformance with the standards prescribed in this Regulation and where no such standard is prescribed, shall meet the appropriate industry standards and codes applicable to such materials;
- (d) a prefabricated tank, including, subject to subclause i of class i, multiple piece units assembled on site, shall conform to the requirements of Canadian Standards Association Standard B66 except as otherwise prescribed herein;
- (e) only those provisions of Canadian Standards Association Standard B66 and this section relating to material standards, access, workmanship and construction methods and practices apply to a tank other than a septic tank in a Class 4 sewage system or a holding tank in a Class 5 sewage system;
- (f) the tank shall be constructed or installed on site according to good construction practice or, where specified, the manufacturer's recommendations, and in a manner that will ensure against,
  - (i) subsequent settlement of the tank or subsequent uplift due to groundwater pressure, that will be disruptive to the sewage system of which the tank is a part,
  - (ii) damage to the tank or any protective coating during handling and back-filling, and
  - (iii) damage to the tank due to weather or frost;
- (g) a prefabricated septic or holding tank shall be constructed so as to meet the requirements for certification by either the Canadian Standards Association or Underwriters' Laboratories of Canada and shall bear the certification mark of either the Canadian Standards Association or Underwriters' Laboratories of Canada and the marking required on a

tank by Canadian Standards Association Standard B66, on the upper surface of the tank at such location that it can be seen after installation is complete by exposing the manhole access that is nearest to the inlet pipe;

- (h) a tank constructed on site of concrete shall be poured-in-place and shall,
  - (i) comply with the requirements of Canadian Standards Association Standard A23.1.
  - (ii) have a balanced design of steel reinforcing sufficient to meet the requirements of clause **b**.
  - (iii) have bar or wire reinforcement in accordance with the requirements of Canadian Standards Association Standard A23.3,
  - (iv) conform to the general requirements appearing in clause 3 of Canadian Standards Association Standard B66 except as otherwise provided herein,
  - (v) have top and bottom slabs of a thickness of at least ten centimetres in the case of a tank having a capacity of 9,000 litres or less and at least fifteen centimetres for a tank having a capacity in excess of 9,000 litres,
  - (vi) have sides and ends with a thickness of at least fifteen centimetres in the case of a tank having a capacity of 27,000 litres or less and at least twenty centimetres for a tank having a capacity in excess of 27,000 litres, and
  - (vii) have an inlet and outlet of such size as required to accommodate the sewage flows;
- (i) a steel tank shall not be,
  - (i) constructed or assembled on site,
  - (ii) coated on the outside with coating method "B" described in clause 4.1.7.1 of Canadian Standards Association Standard B66, or

(iii) coated on the inside with coating method "B" described in Canadian Standards Association Standard B66 if the metal is thinner than 10 gauge.

(2) Subsection 1, except clause **g**, comes into force on the 31st day of December, 1976.

(3) Clause **g** of subsection 1 comes into force on the 1st day of July, 1977.

3. Section 15 of the said Regulation is revoked and the following substituted therefor:

15. The following are prescribed as standards for the operation of a Class 1 sewage system:

(a) subject to clause **b**, a Class 1 sewage system shall receive or be used only for the disposal of human body waste; and

(b) a Class 1 sewage system that has been specifically designed for the biological decomposition of non-waterborne biodegradable kitchen wastes, or that requires the addition of small quantities of vegetable matter to improve the decomposition of human body waste, may receive such wastes in addition to human body waste.

4. Section 19 of the said Regulation is revoked and the following substituted therefor:

19. A sewage system of a type set out in Column 1 of Table 5 shall be located so that no part thereof is closer to an item described in the heading of Column 2, Column 3 or Column 4 of Table 5, than the horizontal distance set opposite the name of such type of sewage system in such column.

**TABLE 4**

Column 1	Column 2
Spring or well other than a well referred to in the next item	100 feet
Well with watertight casing to a depth of 20 feet	50 feet
Building or structure where the bottom of the distribution pipe is below the level of the lowest floor in the building or structure	10 feet
Building or structure where the bottom of the distribution pipe is on the same level or above the level of the lowest floor in the building or structure	25 feet
Property boundary	10 feet
Lake, river, pond, spring, stream, reservoir	50 feet


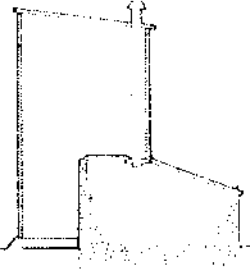

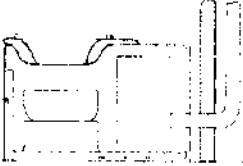
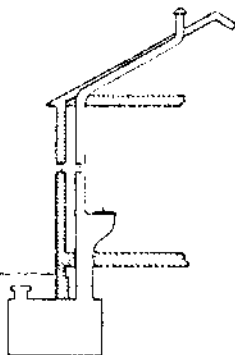
**TABLE 5**

Column 1	Column 2	Column 3	Column 4
	Well with watertight casing to a depth of 20 feet	Spring or well other than a well with watertight casing to a depth of 20 feet	Lake, river, pond, stream, reservoir
Pit Privy	50 feet	100 feet	50 feet
Privy Vault Pail Privy	25 feet	50 feet	25 feet
Cesspool	100 feet	200 feet	50 feet
Leaching Pit	25 feet	50 feet	50 feet

## CLASS 1 SEWAGE DISPOSAL SYSTEMS

Class 1 systems are used only for the disposal of human body wastes and provision must be made to dispose of waste water to a separate sewage system. The conditions under which Class 1 systems are usually permitted are:

- 1) Where the installation of a standard septic tank and tile bed is not possible due to lot conditions
- 2) Where provision is made for the adequate disposal of the waste water to a completely separate system. Class 1 systems are not usually permitted if a premises is served by a pressure water system, as seepage pits usually can not adequately handle large flows.

FACILITY	SUITABILITY	LOCATION	CONSTRUCTION	MAINTENANCE
<p>Earth or Pit Privy</p> 	<p>Where soil available and ground water not encountered. Bottom of pit should be 3' above water table, rock or impermeable soil.</p>	<p>Minimum distances: 50' from cased well 100' from dug well 50' from river, stream, lake, pond, etc. Should be located downgrade from well.</p>	<p>Deep pit, insect and rodent proof. Earth mounted to prevent infiltration of surface water. Pit ventilated.</p>	<p>Good housekeeping required. Natural decomposition of waste should be relatively odourless.</p>
<p>Vault Privy</p> 	<p>Where adequate soil not available for pit privy and protection of ground water is required.</p>	<p>Minimum distances: 25' from cased well 50' from dug well 25' from river, stream, lake, pond, etc. Should be located downgrade from well.</p>	<p>Watertight concrete vault. Flytight building. Ventilated vault and building. 6 cu. ft./person/year.</p>	<p>Keep clean, flytight. Clean pit when contents approach within 18" of door. Disposal of contents to a Class 3 or 7 system.</p>
<p>Removable Pail Privy</p> 	<p>A temporary facility to protect water supply. Where pit privy is impractical.</p>	<p>Minimum distances as per vault privy.</p>	<p>As per vault privy. Provide easily-cleaned pails.</p>	<p>Provide regular collection service and cleaning facilities, including hot water, long-handled brushes, detergent, drained concrete floor. Disposal of contents to Class 3 or 7 system.</p>
<p>Incinerating Toilets &amp; Composting Toilets</p> 	<p>To protect ground water and surface water supplies.</p>	<p>Indoors or adjoining main residence. Should not be used in close proximity to neighbours.</p>	<p>Unit requires a power source. Incinerating toilets also have a cycle time during which it can not be used.</p>	<p>Incinerated ash or dry compost may be disposed of easily, on garden, or buried.</p>
<p>Chemical Toilet</p> 	<p>To protect underground and surface water supplies.</p>	<p>Indoors or adjoining main residence.</p>	<p>As for masonry vault privy. Tank may be heavy gauge metal with protective coating. Capacity 125-250 gallons.</p>	<p>Use 1/4 lb. lye for each cu. ft. of vault capacity. Made up to 6" liquid depth in vault or 25 lbs. caustic soda per seat in 15 gal. water. Maintain chemical solution proper strength to keep odours down and agitate after each use. Clean vault when 2/3 - 3/4 full. Avoid splashing as solution causes burns.</p>

Further information on the installation of toilets, their siting on the lot, the condition of the soil and other details are available from the following regional and district offices of the Ontario Ministry of the Environment:

**NORTHWESTERN REGION:**

**Thunder Bay Regional Office,**  
435 James St. S.,  
Thunder Bay, P7C 5G6  
Tel.: 475-1205

**Kenora District Office,**  
808 Robertson St.,  
Kenora, P9N 1X9  
Tel.: 468-5578

**NORTHEASTERN REGION**

**Sudbury Regional Office,**  
469 Bouchard St., Regency Mall,  
Sudbury, P3E 2K8  
Tel.: 522-8282

**Timmins District Office,**  
83 Algonquin Blvd. W.,  
Timmins, P4N 2R4  
Tel.: 264-9474

**Sault Ste Marie District Office,**  
445 Albert St. E.,  
Sault Ste. Marie, P6A 2J9  
Tel.: 949-4640

**North Bay District Office,**  
1500 Fisher St., Northgate Plaza,  
North Bay, P1B 2H3  
Tel.: 476-1001

**Parry Sound District Office,**  
74 Church St.  
Parry Sound, P2A 1Z1  
Tel.: 746-2139

**SOUTHWESTERN REGION**

**London Regional Office,**  
985 Adelaide St. South,  
London, N6E 1V3  
Tel.: 681-3600

**Windsor District Office,**  
250 Windsor Ave., 6th Floor,  
Windsor, N9A 6V9  
Tel.: 254-5129

**Sarnia District Office,**  
242 A Indian Rd. South,  
Suite 209 S.,  
Sarnia, N7T 3W4  
Tel.: 336-4030

**Owen Sound District Office,**  
220-11th St. West, Suite 108,  
Owen Sound, N4K 1T9  
Tel.: 371-2901

**Chatham Sub-District Office,**  
435 Grand Ave., W.,  
Chatham, N7L 3Z4  
Tel.: 352-5107

**WEST CENTRAL REGION**

**Hamilton Regional Office,**  
140 Centennial Parkway N.,  
Stoney Creek, L8E 3H2  
Tel.: 561-7410

**Cambridge District Office,**  
400 Clyde Rd.,  
Cambridge, N1R 5W6  
Tel.: 623-2080

**Welland District Office,**  
637-641 Niagara St. N.,  
Welland, L3C 1L9  
Tel.: 735-0431

**CENTRAL REGION**

Suite 700, 150 Ferrand Dr.,  
Don Mills, M3C 3C3  
Tel.: 424-3000

**Barrie District Office,**  
12 Fairview Rd.,  
Barrie, L4N 4P3  
Tel.: 726-1730

**Muskoka-Haliburton  
District Office,**  
Gravenhurst, P0C 1G0  
Tel.: 687-3408

**Peterborough District,**  
139 George St., N.,  
Peterborough, K9J 3G6  
Tel.: 743-2972

**Halton-Peel District Office,**  
125 Cross Ave.,  
Oakville, L6J 2W8  
Tel.: 844-5757

**Huntsville Sub-Office,**  
100 Main St. E.,  
Huntsville, P0A 1K0  
Tel.: 798-2386

**Southeastern Region,**  
133 Dalton St.,  
Kingston, K7L 4X6  
Tel.: 549-4000

**Ottawa District Office,**  
2378 Holly Lane,  
Ottawa, K1V 7P1  
Tel.: 521-3450

**Cornwall District Office,**  
4 Montreal Road, 2nd Floor,  
Cornwall, K6H 1B1  
Tel.: 933-7402

**Belleville District Office,**  
15 Victoria Ave.,  
Belleville, K8N 1Z5  
Tel.: 962-9208

**Pembroke District Office,**  
1000 MacKay St.,  
Pembroke, K8A 6X1  
Tel.: 732-3643