WASTE WATER

What is wastewater?

Wastewater is the water we dispose of from our homes, offices and industry. It comes from toilets, sinks, showers, washing machines and industrial processes and was historically called sewage. Household wastewater can be divided into two sub-classes: grey water and black water.

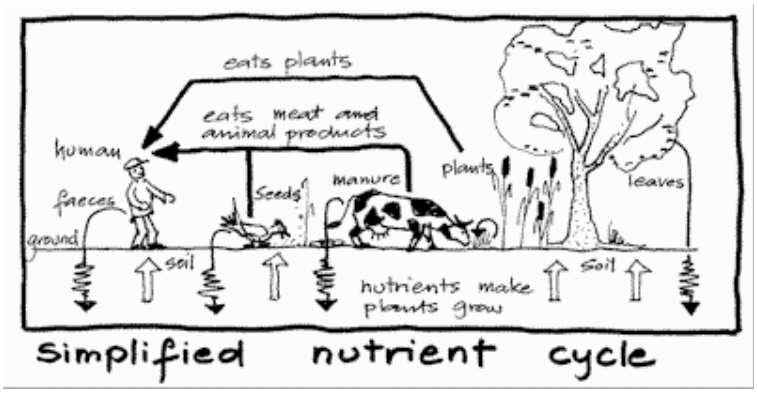
Black water is wastewater from toilets. It contains human waste and can be a public health risk if not treated properly.

Grey water (sullage) is a lesser health risk, because it does not contain human waste. It is the wastewater from the kitchen and bathroom sinks, baths, showers and laundry.

Stormwater, is the rainwater that flows to drains and thence to the nearest stream, lake, pond or coastline. In Waitakere City it is collected in separate drains.

The extra load from stormwater getting into wastewater drains causes major problems with treatment, so Waitakere City puts considerable effort into keeping stormwater out of the wastewater network.

Waste or resource?



Human waste is a natural product that forms part of the nutrient cycle. It contains valuable nutrients, such as carbon and nitrogen, which aid plant growth.

Traditionally human and animal wastes were allowed to break down naturally and the nutrients were given back to the earth. In many cultures human and animal wastes are still seen to be very valuable and are used as fertiliser.

Flush toilets were introduced for increased convenience, especially in cities where population densities and waste volumes were high. Mixed with water, human waste forms a fertile breeding ground for micro-organisms and disease. To protect public health, extensive pipe systems were developed to take the wastewater away from human settlements - often out to sea or into rivers.

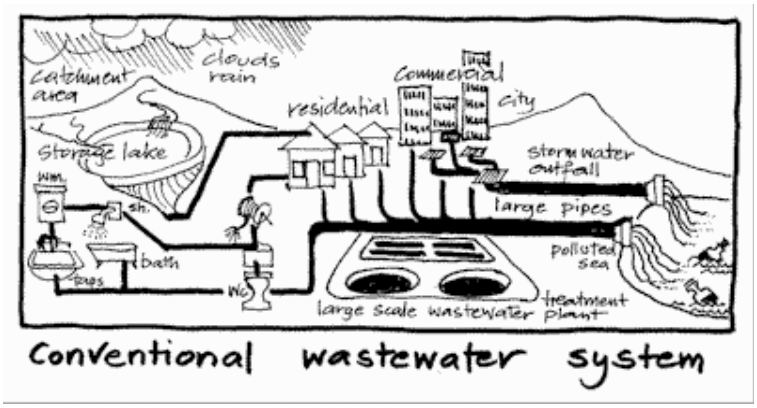
Over time it was realised that our wastewater was polluting waterways and the oceans. The high level of nutrients causes algal blooms and oxygen deficiencies in rivers. In addition there was pollution of chemicals and other products, from industry. Rivers and some coastlines became contaminated to the point where the water was unhealthy to drink or even bathe in.

To protect public health, many cities introduced facilities to treat wastewater before it was discharged.

Nevertheless these systems still cause pollution and result in the loss of nutrients to sea. Most of the food we eat comes from the land and the question is being asked, whether we shouldn't give our waste back to the land to close the nutrient cycle.

Wastewater disposal in Waitakere City

Households in the urban area of Waitakere City – the sewered area -are connected to the centralised wastewater system that takes our waste to the Mangere treatment plant. After treatment, the effluent is discharged into the Manukau Harbour. If you live in the area served by this system your house should connect to it.



The pipe system that takes the waste to Mangere is old and reaching capacity, resulting in leaks and overflows into streams and harbours. Overflows are often caused by stormwater getting into the pipes through cracks, natural drainage into gully traps, and illegal connections like downpipes connected into the wastewater system. As the population increases these problems become worse and the costs of upgrading and maintaining the system increase.

Alternatives for the future are being investigated.

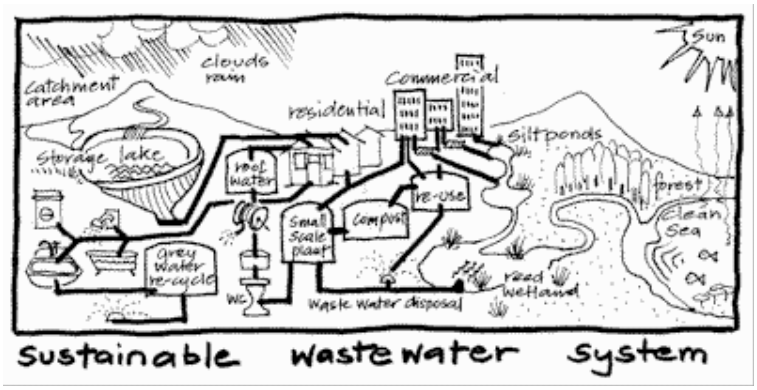
Residents outside the sewered area have on-site disposal systems, such as septic tanks or composting toilets. The responsibility lies with the resident to make sure their system works and does not pollute the environment. These systems can work well and avoid the problem of concentrating all the city's waste at one location such as Mangere. When they do fail the problems are generally (but not always) local.

Many old septic tank systems were poorly designed and sited, or the use they were designed for has changed over time: a bach has grown into a permanent home, for instance, or modern appliances such as automatic washing machines have greatly increased the water discharged into the septic tank. Septic tank problems also arise when the disposal field (where the effluent soaks into the ground) is inadequately constructed for Waitakere City's clay soils, which do not absorb water well.

Reducing the wastewater load

Wastewater is a very small proportion of human waste mixed with a lot of clean water. If we can keep relatively clean water out of wastewater, the volumes that need to be treated are reduced. Stormwater should be disposed to separate stormwater drains, although it can also be collected in tanks for uses that don't need drinking quality water (such as garden irrigation). Some grey water can be re-used in toilets before it finally becomes wastewater. Saving water will also help to reduce the volumes of water. Grey water and storm water do not need the same level of treatment as black water and keeping them separate will reduce pressure on the treatment system (on-site as well as city systems).

Waitakere City Council is looking at a number of options to deal with our wastes in the most sustainable way we can. One option is to aim towards decentralised treatment plants, or neighbourhood plants. This would mean that the waste is treated locally and that it does not have to be piped so far. Grey water can be reused to flush toilets after some treatment or it can be used on the garden. Wastewater can be treated to high quality and used for irrigation, while the solids can be composted. We could discharge the final effluent to land, rather than to sea. There are many more options and they need to be carefully evaluated and discussed with the community.



Stormwater

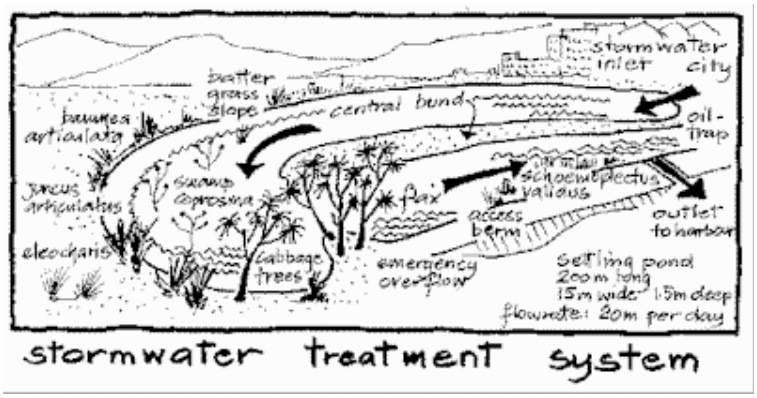
Local councils manage stormwater. On average this costs every ratepayer in Waitakere City $70 a year, but this cost is expected to increase dramatically in future as infrastructure requires renewing or upgrading. To avoid flooding runoff from hard surfaces is collected and piped into drains. From there it generally runs untreated into streams and harbours.

Toxic pollutants such as pesticides or heavy metals from cars, as well as animal wastes, oils and sediments, are mixed with the runoff. These substances pollute our fresh water and marine organisms and also pose a public health risk.

Our estuaries and harbours are poorly flushed and particularly sensitive to stormwater pollution. As a result, aquatic habitat is damaged, plant and animal species decline and fishing or collecting shellfish, can become a health risk. Recreational areas lose value.

Stormwater treatment
Densely populated or ecologically sensitive areas may require storm water treatment. There are a number of instalations in the Auckland area already, and stormwater treatment is becoming more common for both industrial sites and new subdivisions.

The artificial wetland system used to treat stormwater at one industrial site in Auckland, uses a 200 m long pond. The water flows through slowly (it takes about 9 days) while native wetland plants (mainly rushes) help remove and settle particles. The system was engineered to give good results but similar principles could be applied to individual households on a smaller scale. Stormwater treatment systems may require resource consent, so contact your local and regional councils for advice.



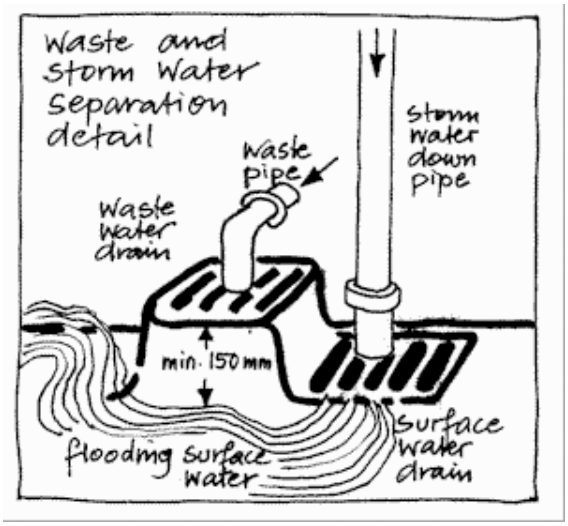
Keep pollutants out of the system

Controlling pollutants individually at the source is relatively easy, while treating them at the outflow is expensive and doesn't happen in most places. So don't just flush things away. Think about where they will emerge from the drainage system.

- Reduce the release of any pollutants into the environment where ever possible: oil leaking from your car, lead from your vehicle exhaust, dust from your brake linings and rust. Reducing car use reduces pollution - you can car-pool, use public transport or walk or cycle instead.
- Don't spill or pour household cleaners, oils and garden sprays into home drains.
- Reduce detergent use and choose biodegradable brands.
- Don't clean your paintbrushes into the stormwater drain.
- Wash your car on the grass, so that soapy water and chemicals can be absorbed before draining into the storm water system or at a car wash that handles the wastewater correctly.
- Be aware of potential erosion when landscaping and building
- Use permeable surfaces such as gravel or hollow blocks around your home, instead of hard surfaces, such as concrete or bitumen.
- If you have a septic tank, make sure it works well. Malfunctioning septic tanks can pollute storm and ground water.

Keep your drains separate

Sewage and storm water drains must be kept separate, because stormwater infiltration into wastewate systems can cause sewage overflows and environmental damage.



Stormwater can also be used to water gardens and for some industrial and household purposes. This might become more common as increasing population puts more pressure on water resources. See also *Using Rainwater*.

Grey water re-cycling

Grey water recycling re-uses water from the bath and shower to flush the toilet. The water has to be treated to avoid bacteria breeding and odours. At the time of writing there is only one ‘off the shelf’ system approved for use, which uses a filter and chlorine to treat the water, before storing it in a holding tank and pumping it to the toilet cistern. In the future more systems will become available.

Grey water can also be used on the garden, but it needs to be free of contamination. The rinse water from washing machines is generally safe for non-food plants, but other water may need further treatment.

Another option is to collect rainwater for toilet flushing and garden use. See *Using Rainwater.*

Wastewater in the urban areas

The national Building Code states: "Where a sewer connection is available, the (home) drainage system shall be connected to the sewer...." On-site systems are therefore, not generally on option if you can connect to a sewer. Contact the Council for advice, if you are considering an on-site system in the urban area.

If you are connected to the main sewer, there are still things you can do to help the system work better. Reducing the amount of water you use is a big help, because water-in equals water-out (see Saving Water). You may be able to re-use your grey water as described above.

Waste disposal units put extra nutrients into the system and wastewater. It is better not to instal them. You can compost your organic waste instead.

The Mangere treatment plant is designed to deal with human waste but not with chemical pollution. Reduce the quantity of toxic substances you use and don't pour them down the drain. The Auckland Regional Council or the Waitakere Solid Waste Business Unit based at the Refuse Transfer station can advise you on the disposal of hazardous waste. Many household cleaners are toxic substances: look for the safer alternatives.

Infiltration of rainwater or groundwater into the sewage system can happen through cracked pipes, illegal connections or inadequate upstands around gully traps.

Looking after a septic tank

Looking after your on-site system is important to ensure that it will not pollute the environment or endanger your health. Waitakere City Council has posted a leaflet on how to care for your on-site system to all residents in the non-sewered area. If you did not receive it or if you would like another copy please ring the Call Centre 839 0400.

Septic tanks can be retrofitted with effluent filters to stop solids from entering the disposal field. The disposal method of the effluent can also be changed (See the section on Effluent and grey-water disposal at the end of this chapter). If you would like to improve your existing system you can get worthwhile advice by contacting the Council and asking for a plumbing and drainage surveyor who specialises in septic tanks.

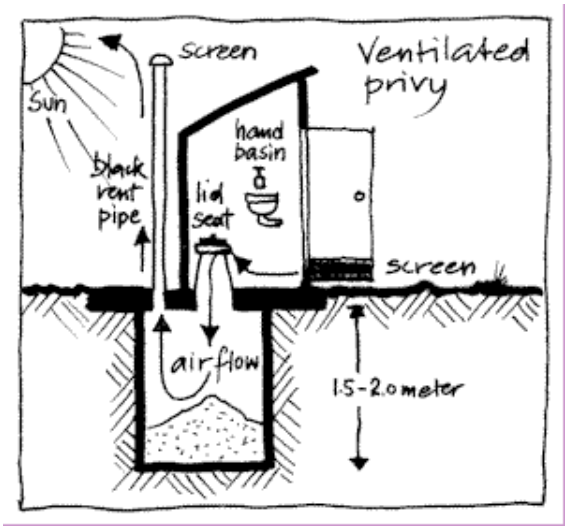
Instaling a new on-site system

For an on-site wastewater system to work well, it has to be suited to the individual site. Soil conditions, the size of the section and household, slopes and ground water levels are all important factors. The location and size of the system is also important.

New on-site systems are usually only allowed in the non-sewered areas of the city. They must be designed by a registered engineer familiar with effluent disposal. The manufacturer's instructions must be followed and a maintenance programme must be put in place to ensure that the health and environment of both your family and neighbours are protected. If you are considering a new system contact the Council 839 0400 and ask to speak to a Plumbing and Drainage Inspector who specialises in septic tanks.

The following list covers the most common systems, a list of systems available and suppliers can be found at the end of the chapter:

The **Long drop** is a simple hole in the ground in a separate building from the house, away from water tables. This is not the most preferred option.

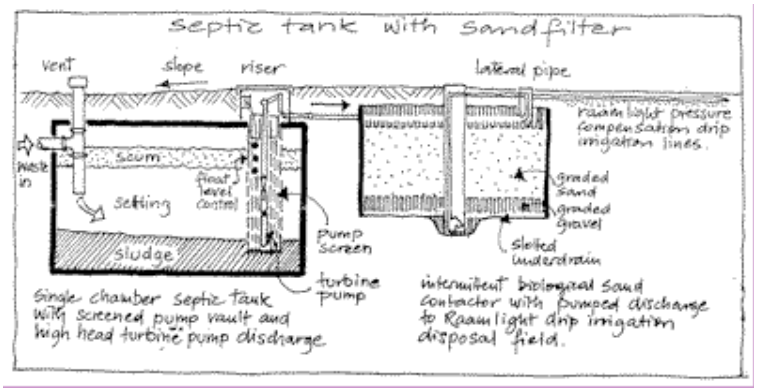


The **Ventilated privy** has a similar set-up to the long drop, with the addition of a vent pipe to help reduce odours. Another variation (aqua privy) contains the waste in a water tank. This will prevent seepage into the water table but does not solve the problem of anaerobic storage.

The **Septic tank** has been used widely in the past and still serves many households today. It pre-treats domestic wastewater before it enters the disposal field where natural processes are expected to take care of the final treatment. In the tank solids settle to the bottom and form a layer of sludge, which is removed by a contractor approximately every three years. Lighter waste such as grease and fats float to the top forming the scum layer. This layer prevents some of the offensive odour from escaping. Anaerobic breakdown (using bacteria that can live without oxygen) treats the waste in the tank to a certain extent. Each time new waste is discharged into the tank, the same amount of pre-treated effluent flows out into the disposal bed where it is exposed to the air and broken down further.

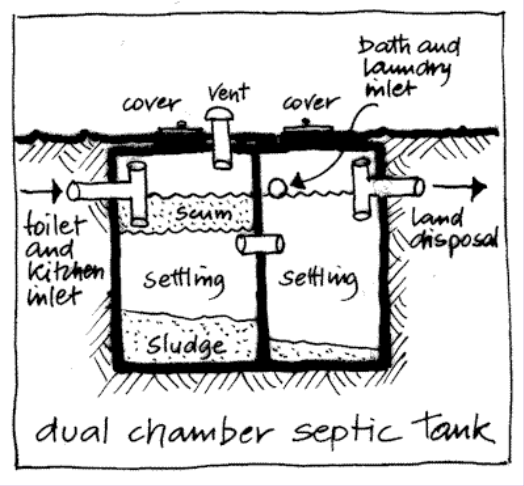
Well-designed and sited septic tanks can work satisfactorily but the owner needs to care for them. Failures can result from poorly sized and sited tanks, inadequate disposal fields, extreme weather and ground conditions (such as clay soils or high ground water levels) and inappropriate occupant behaviour and lifestyles (large water use from modern appliances, use of toxic household chemicals, etc.). Failure of septic tanks can result in widespread environmental damage such as pollution. This is why they are now seldom instaled as the sole treatment system.

A common and very satisfactory solution nowadays is to add an aerobic sandfilter to the outlet of a conventional septic tank.



Based on one of Innoflow Technologies' systems

The sandfilter treats the effluent from the septic tank to a very high quality and the final product can be used for garden irrigation, or it could be re-used for toilet flushing. Like all on site systems this system needs to be covered by a service maintenance agreement.

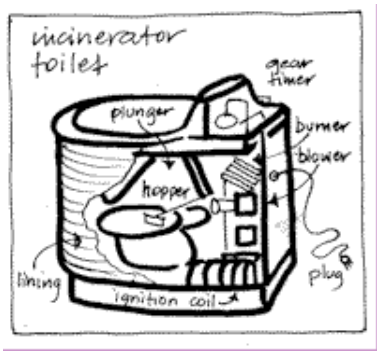


The **dual chamber septic tank** is similar to the septic tank, but has two chambers. Only toilet and kitchen wastewaters pass through the first chamber. Wastewater from the bathroom and laundry is added at the second chamber. This design avoids some of the problems of single chamber septic tanks, because large discharges from the laundry will not result in untreated toilet waste flowing into the disposal field.

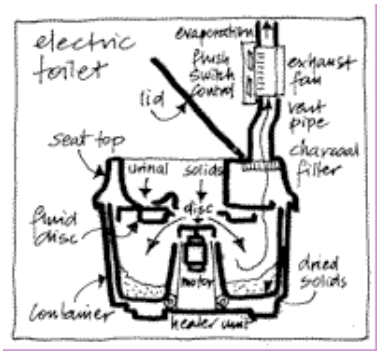
Aerobic treatment plants offer a mechanical solution to wastewater treatment in an aerobic treatment tank with drip irrigation onto the garden. The wastewater is aerated which allows aerobic bacteria to break down the waste. These systems require energy and ongoing maintenance.

The **incinerator toilet** uses combustion and venting to resolve odour and contamination problems, but it does not return any valuable matter to nature and uses significant energy.

The **electric toilet** mixes and aerates the effluent on a rotating disc, then heats and evaporates the liquids by venting through an automatic air extraction system. This reduces the original waste volume by 90% to dry turf, which can be composted. This is an ecological solution with relatively high running costs.

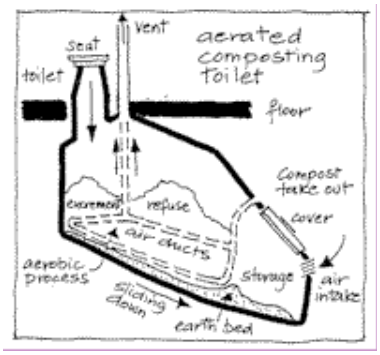


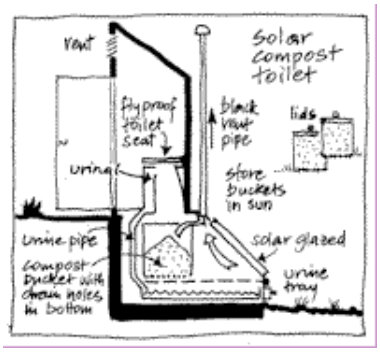
Based on ‘Destroilet’



Based on ‘Lectrolav’

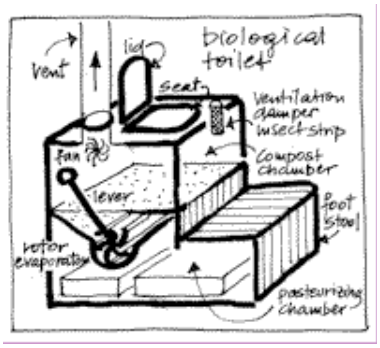
The **aerated composting toilet** is a true composting toilet with an aerated storage tank. The waste is mixed by gravity, while venting and aeration is achieved by the thermo-syphon principle. The tank requires space to instal below the bathroom.

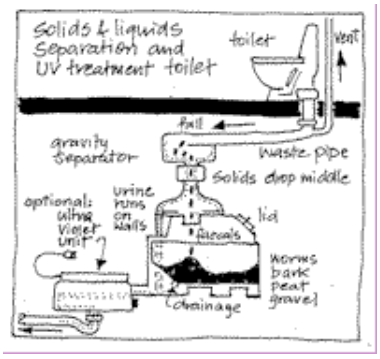




The **solar compost toilet** is a simple natural solution, allowing for composting, heating by solar radiation, and venting by thermo-syphon. Solids and liquids are separated and flies and odours are controlled by a perforated tray. The compost is removed by swapping buckets.

The **biological toilet** is an environmentally friendly system, which requires some electrical energy input to keep the waste rotating, heated and vented.

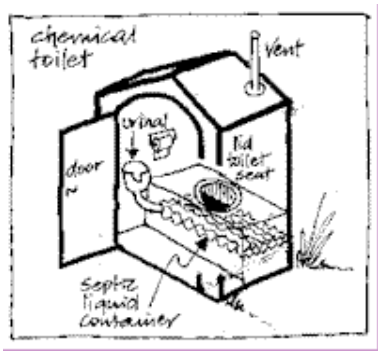




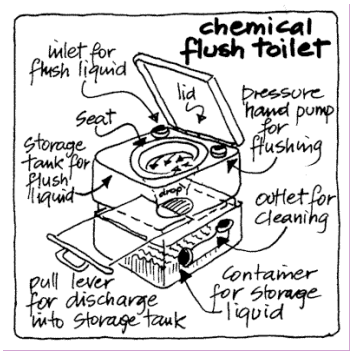
Based on ‘Mullbank’ Based on ‘Aquatron’

Solid/fluid separation systems are mechanical equivalents to the solar composting toilet, separating solid and liquid effluent, while providing a conventional flush toilet. The solids are composted with the help of worms, while the liquid is disposed of after further treatment. Some systems allow for the reuse of the cleaned effluent for toilet flushing and other uses. The system can be placed underneath the toilet or outside in a shed or underground.

The **chemical toilet** and **chemical flush toilet** are only solutions for temporary situations. They treat the waste with chemicals to resolve odour and contamination problems. Further processing and proper disposal are still required.



Based on 'Port-a-loo'



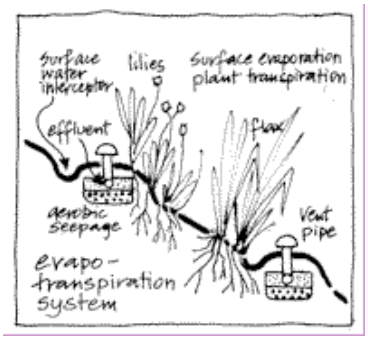
Based on ‘Porta potti’

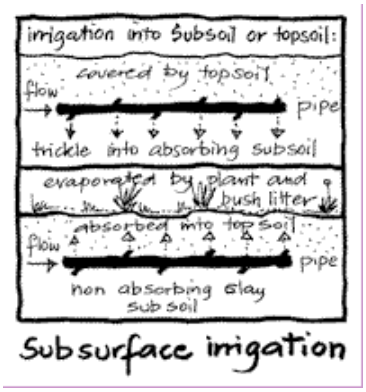
Effluent and grey-water disposal

Once the wastewater has been treated by a septic tank or another water-based system the final effluent is either further treated or disposed of. Where a dry toilet system, such as a composting toilet, is used grey-water from washing, etc., still has to be treated and disposed of. The following list is not exhaustive, but gives some examples of possible solutions to disposing of effluent.

The **sand filtration system** uses various grain sizes of sand and gravel. It will take out some pollutants from black and grey water, but not chemicals or sludge, which should be dealt with beforehand in a retention tank. The final effluent can be used for garden irrigation.

Evapo-transpiration systems use sub-surface soakage and evapo-transpiration from selected plants. The plants absorb effluent into their root system and then release water to the atmosphere through their leaves. **Aerobic soakage beds** are a similar system using shallower narrower beds. The effluent is also dosed so that a larger amount can be released into the system at one time.

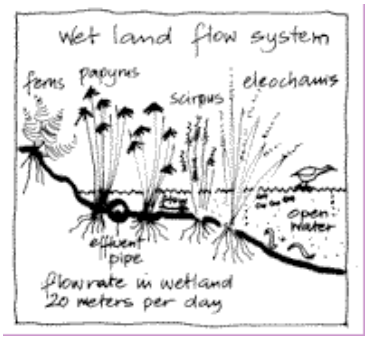


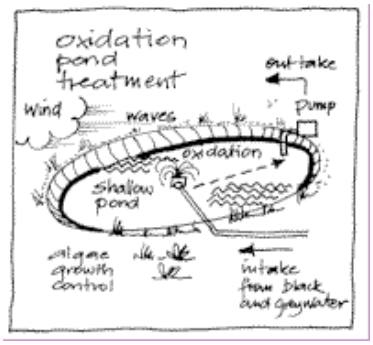


Compensated dripper-lines are covered with bark or mulch and discharge the effluent to the ground. They are laid around bush and landscaped areas (not vegetable gardens) and can be used as irrigation.

Wetland flow systems can be either sub surface or surface operated. In the former, the effluent is percolated over several days through gravel beds and aquatic reeds, on top of impermeable clay soils. A surface system needs a slow surface flow of 10-20 m per day through aquatic reeds. These systems purify water in a very

natural way, but because of the need to design and size them correctly to avoid pollution of waterways, **Auckland Regional Council approval has to be obtained.**





In an **oxidation pond** system the effluent is disposed into the centre of a shallow pond, where wind, oxidation and algae allow for aerobic treatment. **Auckland Regional Council approval has to be obtained for this system.**

Further information:

BBE No10 Water and No 24 Permaculture
Available from the Building Biology & Ecology Institute of NZ, PO Box 35921, Browns Bay, Northshore City, Auckland.
The Toilet Papers, Sim van der Ryn, 1980, Capra Press, USA
Wastewater Disposal Systems for Domestic Households, Ian Gunn, Waiheke Island Seminar, 1991
Review of Composting Toilets, Bruce Corker, 1991
TP (Technical Publication) 58, Auckland Regional Council.

Advice at Waitakere City Council:
Eco-friendly Building 8368000 Ext. 8365
Plumbing and Drainage Surveyor, Septic Tanks 839 0400
Building Consents 839 0400
Planning and Resource Consents 839 0400
Leaks and General Water Enquiries 839 0400

Further information can be obtained from the contributing writers for this chapter of Waitakere City's Sustainable Building Sourcebook.
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