


**Division of Mines and Mineral Resources — Report 1990/08**

# Geological and hydrogeological setting of the main tip sites throughout Tasmania

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## Abstract

This study provides information regarding the potential for groundwater contamination both within superficial materials (generally Quaternary deposits) and the basement fractured rocks to establish a better understanding of tip siting. Field investigations were undertaken between February and March 1990. The work consisted of a short investigation of landfill sites, including the geological settings and general site management. About 70 tips were assessed for rock permeability, depth to the basement and depth to the water table in very different geological and hydrogeological settings throughout Tasmania. Geological maps (1:50 000 and 1:250 000 scale sheets) were used to indicate the likely underlying basement rocks in the vicinity of tips.

The results of this study lead to the conclusion that there is frequently a significant potential for groundwater and also for surface water contamination at many existing sites. Because it is difficult to determine the potential for contamination from a short surface inspection, more detailed investigations are advised at some tips in order to gain a better understanding of geological and hydrogeological conditions.

## INTRODUCTION

The Division of Mines and Mineral Resources of the Department of Resources and Energy administers the Groundwater Act (1985), and the Division's Engineering Geology and Groundwater Branch is involved in tip siting, mainly because of the potential for groundwater contamination at landfill sites.

A large quantity of domestic wastes is produced every year throughout Tasmania, and the siting of suitable tip sites is a major concern for most of the Municipal Councils around the State which, in most cases, are required to get a licence to operate from the Department of the Environment and Planning. During this licensing process, the Division of Mines and Mineral Resources is often contacted to advise on the feasibility of these future refuse disposal projects from the geological and groundwater pollution point of view.

At present, geological investigations are frequently carried out on behalf of the Department of Environment and Planning and/or the Councils. These investigations may be undertaken before the start of waste disposal (site assessment for future tips), or during and after operations begin (monitoring on existing tip sites). Advice provided by the Division of Mines and Mineral Resources should aid in reducing greatly the potential for groundwater contamination.

In the past very little attention has been given to siting tips, and landfill sites have generally been established without taking the geological and hydrogeological setting into consideration. The result is that most of the current tip sites are not entirely suitable for waste disposal from a geological point of view, and there is frequently a significant potential for groundwater and/or surface water pollution.

There are many aspects to consider in order to protect groundwater in the area surrounding tips (choice of suitable site, collection of leachate and stormwater, treatment of leachate, etc.). The protection of groundwater should be an obligation for all Councils because most groundwater in Tasmania is of good quality and it is important that this quality be maintained wherever possible. The current users and potential users of groundwater should be protected.

Suitable tip sites are likely to occur throughout Tasmania, and further investigations should be systematically undertaken to locate appropriate sites. A smaller number of well managed tips would be a significant step in the right direction, as would an improvement of management on a lot of current sites (e.g. trenches should be smaller so that wastes can be sealed very quickly after disposal with low permeability material, etc.).

Groundwater is not a large source of the total water used in the State but its use is increasing with time. Water supplies at Currie on King Island and Lady Barron on Flinders Island are entirely provided by groundwater and other towns, such as Deloraine and Winnaleah, are partly dependent on groundwater. Irrigation of crops and recreation areas (golf courses, etc.) is becoming significant, as is the use of groundwater on farm properties for domestic, garden and stock watering.

There are a large number of tips in Tasmania (about 140 are listed in Department of Environment and Planning records, with others in small local communities); most of them are small (Tomahawk, Beechford, Weldborough etc.), whereas a few landfills are relatively large (e.g. Lauderdale, Hobart, Launceston, Glenorchy, Ulverstone). However all have the potential to contaminate the groundwater if conditions are unfavourable, i.e. poorly-sited geologically. Some tip sites are situated near rivers (e.g. Huonville, Queenstown) and/or shorelines (e.g. Ulverstone, Smithton) where there is a significant potential for the pollution of surface water.

Other tips are located in areas where there is obvious groundwater contamination, e.g. in sand and gravel material (alluvium, windblown sand formation) or where basement is not protected by an adequate thickness of low permeability material, such as clay.

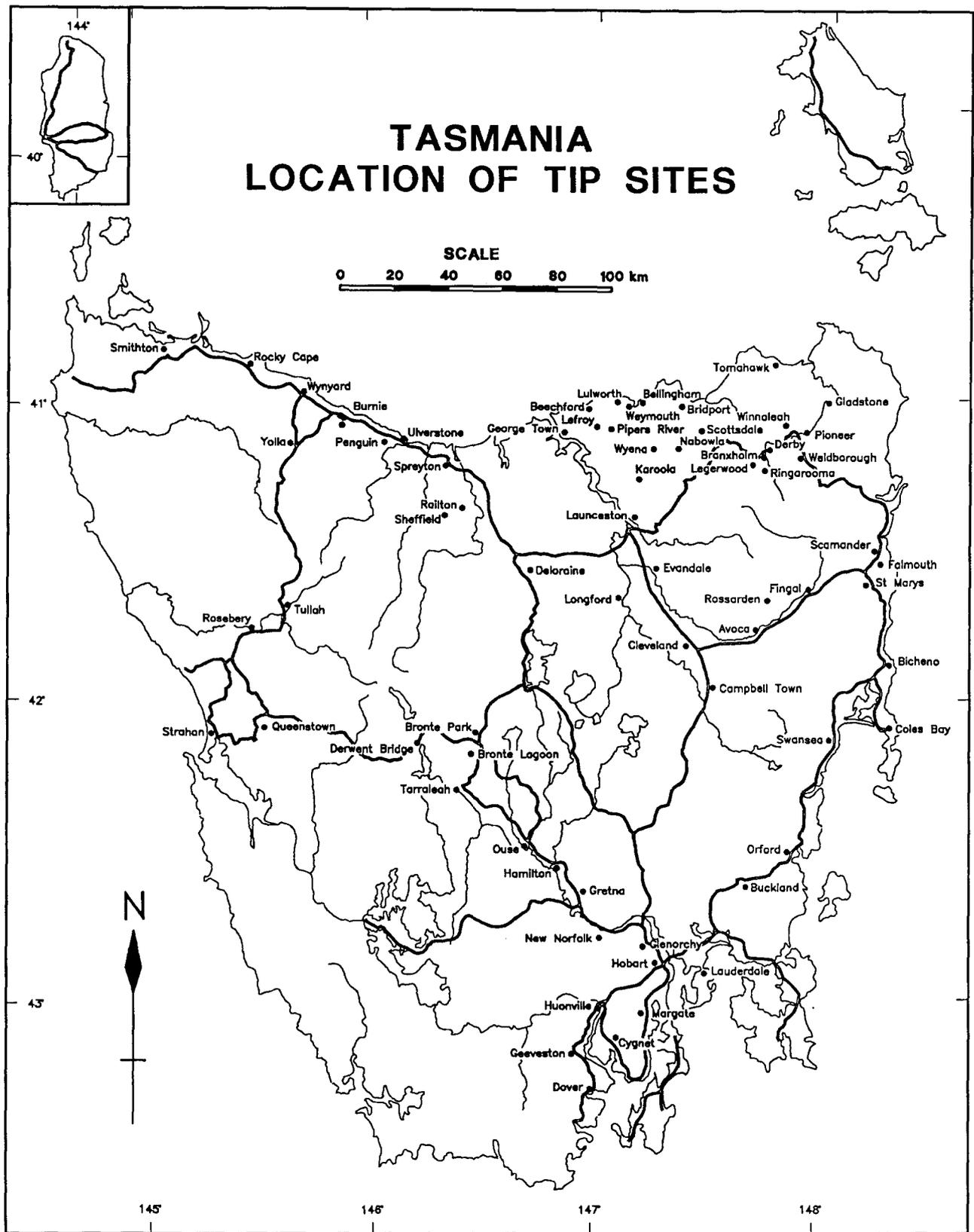


Figure 1.

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**DESCRIPTIONS OF TIPS**

**MUNICIPALITY OF BURNIE**

**BURNIE tip, Mooreville Road x Three Mile Line Road**

*Status*

Current. Operations on this site (new Burnie tip) have just begun. Wastes are dumped on the surface after a layer of soil (mainly clay) has been stripped away. This low permeability material is used to cover the wastes after the operation for that part is completed.

*Geology (Burnie sheet) and hydrogeology*

This site was investigated during February 1990, when four boreholes (maximum depth 60 m) were drilled in the surrounding area. The purpose of these bores was to monitor the quality of water in the underlying Tertiary basalt and interbedded sediments. All bores penetrated approximately five metres of residual soil, consisting mainly of low permeability clay, and an alternation of weathered and fresh basalt of Tertiary age. These basalt flows were interbedded with sand and gravel deposits in two of the holes.

The permeability of this formation is expected to be very heterogeneous, being low in unfractured basalt and in sediments with a clay matrix but it is possibly moderate to high in fractured and weathered basalt.

Water was struck at different levels, with these bores yielding between 40 and 80 L/min (500–1000 gallons/hour). One of the bores was artesian, while the level of the water table was about five metres below the surface in the other bores.

The Tertiary basalt is likely to be underlain by Precambrian rocks consisting of quartzite and slate (Burnie Quartzite and Slate). The depth to this formation varies considerably, and it is difficult to assess at this site.

There is a significant potential for groundwater contamination of the basalt aquifer at this site. An investigation is in progress to determine if the groundwater is polluted by leachate generated from the landfill site.

In general, these types of sites should not be chosen for refuse disposal in the future unless investigations show that leachate can be controlled. Basalt aquifers usually provide good quality water with useful yields but clay horizons of sufficient thickness might prevent groundwater contamination on this site if management practices are good (wastes sealed, stormwater diverted and leachate collected).

**BURNIE tip, off View Road**

*Status*

Closed. This tip is located about 2 km north of the new Burnie tip (see above).

Wastes are sealed with low permeability material (residual soil produced by basalt weathering). It is not possible to observe the contact between wastes and the underlying geological formation (basalt?). However the geological setting may be very similar to the new Burnie tip (see above), so that there is potential for groundwater contamination to occur on this site.

**MUNICIPALITY OF CAMPBELL TOWN**

**CAMPBELL TOWN tip**

*Status*

Current. Trench system (Length 40 m, width 3 m, depth 4 m) for domestic wastes, with garden wastes/grass and branches being deposited on the surface nearby. Old trenches have been partly sealed with sand material of moderate permeability.

*Geology (Lake River sheet) and hydrogeology*

The currently operating trench has been dug in fine-grained grey sand corresponding to a Quaternary windblown sand formation. The permeability is expected to be moderate. However at this site the Quaternary sand formation is relatively thin, and some old trenches might have been dug in weathered basalt. The depth to the basement (basalt) is very shallow and some boreholes in the surrounding area have yielded appreciable quantities of water (up to 1500 L/min). Although the water quality is not good (about 2000 mg/L TDS), it may be suitable for irrigation on well-drained soils and could be used as a stock supply.

There is a significant risk of groundwater contamination at this site because of the shallow depth of the Tertiary basalt. The overlying sand formation is likely to allow leachate infiltration.

The Quaternary sand formation may also be an aquifer but it is anticipated to be of very limited extent. Management would be greatly improved by sealing trenches with low permeability material (clay), and monitoring should be undertaken to determine the shape and the extent of the contamination plume in the basalt aquifer.

**CLEVELAND Tip**

*Status*

Current. Trench system (L:30, W:2, D:3 m). Old trenches have been sealed with low permeability material.

*Geology (Lake River sheet) and hydrogeology*

In the trench, 0.5 m of fine-grained sand (grey) at the top is underlain by brown-orange pebbly clay. The latter material is likely to be the product of weathering of the underlying Tertiary basalt, and the permeability is very low. Information provided by a nearby borehole shows that fresh basalt lies about 20 m below the surface. The Tertiary basalt may be a fractured aquifer capable of providing good water supplies.

There is probably little potential for groundwater contamination within the basalt aquifer on this landfill site due to the significant thickness of low permeability material (pebbly clay). The site management is very good, and there appears to be no problems.

**MUNICIPALITY OF CIRCULAR HEAD**

**ROCKY CAPE tip, National Park**

*Status*

Closed because the tip lies in a National Park.

Wastes were dumped in an old quarry which provided material for road construction. Wastes are not sealed.

*Geology (Smithton sheet) and hydrogeology*

This tip lies in a formation consisting of variably cemented quartzite talus (Quaternary). The overall permeability is expected to be relatively low but it may be moderate in some zones where the talus is quite loose. The talus is underlain by *in situ* Precambrian quartzite which represents the basement. The depth to this formation may be only a few metres (about 2–3 m) below the bottom of the quarry. The quartzite is usually sufficiently fractured to be regarded as an aquifer.

Groundwater contamination of the fractured quartzite aquifer may occur at this site. Leachate generated in wastes can easily infiltrate through the talus formation to the water table in the quartzite formation.

**SMITHTON tip, Kemps Bay**

*Status*

Current. Only one year of use remaining.

Trench system (1.5–2 m deep). Old trenches have been sealed with sand only.

*Geology (Smithton sheet) and hydrogeology*

Fine-grained sand was observed in the trench with no sign of clay horizons. Some sand layers have a rich organic content (black sand). The sand is a Quaternary formation and its permeability is moderate. The water table in the sand formation may be very close to the bottom of the trench.

The basement rock consists of Precambrian dolomite and the depth to this formation may be only a few metres (5–10 m) below the bottom of the trenches.

The permeability of dolomite depends on both fracturing and dissolution, and bores in dolomite are often successful. Dolomite is known to occur in boreholes to the south.

Groundwater contamination of both the surface sand aquifer and the dolomite aquifer is probable at this site. Monitoring should be carried out in the surrounding area to determine the degree of pollution and its extent (contamination plumes).

The tip is located very close to the shoreline and pollution of the sea might also occur.

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**MUNICIPALITY OF CLARENCE**

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**LAUDERDALE tip**

*Status*

Current. Wastes are dumped on the ground surface and partially sealed.

*Geology (Hobart sheet) and hydrogeology*

This tip is underlain by an interbedded sequence of sand, sandy clay and clay. The total thickness of this Quaternary material (including some windblown sand) is unknown but it is greater than seven metres (previous borehole information in the surrounding area). These materials, consisting mainly of clayey sand and sandy clay, are considered to have a moderate permeability. They vary considerably in profile (with depth).

The basement rock consists of either Jurassic dolerite or Permian quartz sandstone and siltstone. Depth to the basement is difficult to assess because of faulting in the region but it is likely to be more than ten metres below the surface. Drilling has shown the Quaternary sequence to be a multi-level aquifer; water table levels are less than one metre below the surface across the site. The basement rock may also contain groundwater and the standing water level could be quite shallow.

This is not a good tip site because of the potential of groundwater contamination in both the Quaternary and the basement rocks (dolerite or sandstone). An investigation is currently in progress to determine the extent of pollution within the Quaternary aquifer. Results have shown that there is an existing contamination problem within the near-surface sequence.

There is no information on groundwater contamination in the basement rocks. Contamination will depend mainly on the thickness of the Quaternary formation and on the depth of the water table in the basement material. Further drilling would be necessary to determine these unknown parameters.

The site is located very close to the sea, and the groundwater in the near-surface material is salty. However some sand dunes located on the site boundary may contain water of good quality suitable for water supplies, although a mixing between fresh water and salt water probably occurs.

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**MUNICIPALITY OF DEVONPORT**

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**SPREYTON tip**

*Status*

Current. Wastes are dumped on the ground surface along the Mersey River and only partially sealed.

*Geology (Devonport sheet) and hydrogeology*

This tip lies on Quaternary alluvium deposits consisting of gravel in a sand-silt matrix. The permeability of this formation is considered to be moderate and its thickness may not be large (<10 m). This Quaternary formation is underlain by Permian mudstone. The permeability of the basement may be expected to be low unless the rocks are fractured. The Permian is a reliable aquifer to the south.

There is obviously contamination of groundwater in the Quaternary material which consists of a sequence of sand and gravel. Some groundwater contamination of the basement aquifer may be expected due to its shallow depth. This tip also has potential for pollution of surface water because of the proximity of the Mersey River.

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**MUNICIPALITY OF DELORAINE**

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**DELORAINE tip, Quamby Road**

*Status*

Current. Wastes are spilled on the ground and not sealed. They form a 10 m thick bank above the natural ground.

*Geology (Quamby sheet) and hydrogeology*

This site is underlain by a soil consisting of pebbly clay and silt, probably corresponding to river terrace deposits. This Quaternary formation is expected to have a low permeability but it may be only a few metres thick (less than 5 m). The depth to the Cambrian basement, consisting mainly of pebble and cobble conglomerate with an argillaceous matrix, may be

very shallow. These basement rocks may represent a fractured aquifer but there is no information available about the hydrogeology of this formation.

There is potential for groundwater contamination of the basement rocks at this site. However any contamination will depend on the depth to the water table and the degree of fracturing.

Management seems to be the biggest problem on this site.

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## MUNICIPALITY OF ESPERANCE

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### DOVER tip

#### *Status*

Current. In use for more than 20 years, with only about one year of use remaining.

Trench system (1.5–2 m deep) at present, but in the past waste has been dumped on the ground surface and sealed. Leachate and stormwater are drained from the trenches but are not collected for treatment.

#### *Geology (Hobart sheet, only 1:250 000 available) and hydrogeology*

Trenches are dug in weathered sandstone to a depth at which digging is difficult. Some horizons of pebbly clay were observed in the trench. The permeability of this fine to very coarse-grained sandstone is considered to be moderate.

This sandstone corresponds to a glaciomarine sequence of pebbly mudstone, sandstone and limestone of Upper Carboniferous–Permian age. It represents the basement rocks of the region and may contain groundwater. The level to the water table is not known but is probably quite deep.

There is potential for groundwater contamination in the basement rocks on this site. Pollution of surface water may be expected because leachate flows out of the trench to a creek and then probably to the sea.

### GEEVESTON tip

#### *Status*

Current. Trench system (4.5 m deep). Old trenches have been sealed but with sand material only. Water was observed lying in the trench.

#### *Geology (Hobart sheet, only 1:250 000 available) and hydrogeology*

The geological setting is similar to the Dover tip (see above) but the thickness of weathered sandstone is greater (>5 metres). The sandstone is fine to medium-grained and its permeability is considered to be moderate. There is no sign of clay horizons in the trench. The level of the water table in the Upper Carboniferous–Permian formation is not known but it is anticipated to be deep.

There is a potential for groundwater contamination at this site. The contamination problem is similar to that at the Dover tip but at the Geeveston landfill the site management is not as good. There may be a problem of surface water pollution because of the proximity of the river. A dam has been built on this river about 500 m downstream and it impounds a reservoir which was previously used as a water supply for the town.

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## MUNICIPALITY OF EVANDALE

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### EVANDALE tip

#### *Status*

Current. This site is partially utilised as a transfer station for domestic rubbish, and only garden refuse (grass cuttings, etc.) is deposited on the landfill.

Wastes are dumped on the ground surface and they form a five metre high bank above the surrounding plain.

#### *Geology (Longford sheet) and hydrogeology*

This site is underlain by river terrace deposits consisting of sand and gravel (may be Tertiary age). Gravel and sand in a silt matrix have been deposited and only a few clay horizons are present. The permeability of this formation is considered to be moderate to high.

Existing boreholes, located a couple of kilometres to the north, indicate that this formation is not thick (<10 m) and is underlain by Tertiary sediments consisting mainly of lacustrine clay of very low permeability. These deposits are very thick (more than 100 m) and the depth to the Permian siltstone (basement) is large.

There is a potential for groundwater contamination at this site within the surface material due to the anticipated shallow depth of the water table and the relatively high permeability of these sediments. However this aquifer may be very local in lateral extent, so that any contamination will be confined to the immediate area.

There is little potential for contamination within the Permian siltstone aquifer because of the thickness of the overlying low-permeability Tertiary sediments (clay). The sand aquifers in the Tertiary are likely to be protected by overlying clay.

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## MUNICIPALITY OF FINGAL

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### AVOCA tip, Storys Creek Road

#### *Status*

Current. Trench system (L:60, W:5, D:5 m). Old trenches have been sealed. The operational trench has a slight slope at the bottom and a small outlet drains leachate from the trench.

#### *Geology (Oatlands sheet, only 1:250 000 available) and hydrogeology*

The operational trench was nearly full so that it was not possible to observe the geology. However a few outcrops observed in the surrounding area indicate that this site may lie in Permian mudstone corresponding to the glaciomarine sequence of pebbly mudstone and limestone (Parameener Supergroup). These rocks represent the basement and they probably contain groundwater but the depth to the water table is unknown. Because of the location of the site the depth to the water table is expected to be quite deep (probably more than 10 m) but it may be much closer to the surface, possibly 3–10 metres, in low-lying areas.

There is a slight risk of groundwater contamination on this site but this will depend on both the depth to the water table and the density of fractures and joints within the Permian mudstone.

**FALMOUTH tip, Falmouth Road**

*Status*

Current. Trench system (L:50, W:6, D:3 m). There is a slope at the bottom of the trench and a small trench drains out leachate. The leachates are not collected and may infiltrate into the underlying materials.

*Geology (St Marys sheet) and hydrogeology*

Mainly clay and pebbly clay were observed in the trench. This material is likely to have been produced by the weathering of the underlying formation (probably Mathinna Beds). The permeability is expected to be low.

Some horizons of quartz grit were observed, mainly in the top of the section as well as on the surface. This quartz-rich material was probably derived from the weathering of the surrounding igneous rocks (St Marys Porphyrite) of Devonian age.

The basement rock is either interbedded quartzwacke and mudstone (Mathinna Beds) or quartz porphyrite (St Marys Porphyrite), both of which may contain groundwater. The depth to the basement rock is expected to be less than 10 metres.

There is some potential for groundwater contamination in the underlying fractured rocks but more information would be necessary to determine the hydrogeological setting more precisely.

**FINGAL tip, Mangana Road**

*Status*

Current. Trench system (L:60, W:5, D:5 m). Old trenches have been sealed with low permeability material.

*Geology (Ben Lomond sheet) and hydrogeology*

There is mainly clay and pebbly clay in the trench. Most pebbles are angular and they consist of mudstone and some quartz. The permeability of this material is expected to be low. The basement rocks are likely to be a quartzwacke turbidite sequence of interbedded sandstone, siltstone and mudstone (Mathinna Beds), and the unweathered formation may be a few metres below the bottom of the trench. Generally, this Early Devonian-Silurian formation is a good fractured aquifer, and bores have a fairly high success rate.

Groundwater contamination may occur in the basement material at this landfill site but further information would be necessary for a better understanding of the situation. Important parameters such as thickness of the weathered material at the surface, the fracture density of the mudstone, and the depth to the water table are not known.

**ROSSARDEN tip, Rossarden Road**

*Status*

Current. This tip has been developed by the placement of rubbish in a small valley. Scattered deposits of refuse occur throughout the site.

*Geology (Ben Lomond sheet) and hydrogeology*

It is difficult to know what formation underlies this site because of the lack of outcrop in the surrounding area. However it is expected that the site is underlain by mudstone, as a lot of fragments were observed on the surface. The site

appears to be located on an area of interbedded sandstone, siltstone and mudstone (Mathinna Beds) of Silurian-Early Devonian age.

There is a potential for groundwater contamination at this site within the fractured rocks of the Mathinna Beds. The depth to this formation may be very small, and there is unlikely to be a significant layer of low permeability material to prevent leachate infiltration. Further information would be necessary for a better understanding of the situation, and monitoring should be carried out on this site.

**SCAMANDER tip, Tasman Highway**

*Status*

Current. Trench system (L:60, W:5, D:5 m) for domestic wastes. Branches, lawn clippings and earth have been dumped on the ground surface. Old trenches have been sealed with low permeability material.

*Geology (St Helens sheet) and hydrogeology*

Silt and pebbly clay were observed in the trench and this material is obviously the product of weathering of the underlying formation (Mathinna Beds).

Several outcrops of slightly weathered rock were also observed in the surrounding area and it may be expected that the depth to basement rock is very small. *In situ* rock probably occurs at the bottom of the trench.

There is a potential for groundwater contamination at this site within the Devonian age Mathinna Beds, which consists of an interbedded sequence of sandstone and mudstone. This formation usually provides good quality water, and the success rate of water bores is high (80%).

**ST MARYS tip**

*Status*

Current. Trench system (L:100, W:5, D:4 m) with drain to allow leachate to run out of the trench. Old trenches have been sealed.

*Geology (St Marys sheet) and hydrogeology*

About one metre of pebbly clay underlain by slightly weathered mudstone were observed from the top to the bottom of the trench. Unweathered rocks, consisting of a sequence of interbedded Devonian sandstone and mudstone (Mathinna Beds), are expected to occur at the bottom of the trench.

There is a risk of groundwater contamination within the basement Mathinna Beds rock but the significance and extent of pollution will greatly depend on the fracture density and the depth to the water table, which are unknown at the present.

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**MUNICIPALITY OF GEORGE TOWN**

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**BEECHFORD tip**

*Status*

Current. Trench system (L:10, W:10, D:5 m). A narrow drain allows stormwater and leachate to run out of the trench.

*Geology (Beaconsfield sheet) and hydrogeology*

Deposits observed in the trench (from top to bottom) are: fine to medium-grained sand (grey) with only a few pebbles in some horizons. This formation corresponds to Quaternary

coastal deposits, some being windblown sand. Its permeability is moderate.

These sand deposits are probably underlain by Tertiary basalt; as numerous outcrops occur in the surrounding area. The basalt may be a fractured aquifer and contain groundwater.

The depth to basement rock, consisting of Siluro-Devonian sandstone, is not known and this rock may also contain groundwater.

There is obviously contamination of the basalt aquifer at this site and there is also a potential for contamination of any groundwater in the underlying sandstone.

Trenches should be sealed with low permeability material instead of sand to improve management on this site.

#### **BELLINGHAM tip**

##### *Status*

Current. Trench system, old trenches have been sealed with low permeability material.

##### *Geology (Pipers River sheet) and hydrogeology*

The following deposits were observed in the trench (from top to bottom): approximately one metre of fine-grained sand (grey) corresponding to a Quaternary windblown sand, and then more than two metres of sandy clay and clay which are the weathering product of the underlying Siluro-Devonian sandstone and siltstone (Mathinna Beds). The clay has a very low permeability.

The depth to the sandstone basement is expected to be shallow (<10 m) because many outcrops occur close to the tip in the surrounding area. Siluro-Devonian sandstone may contain groundwater but the level of water table is difficult to assess.

There is unlikely to be any groundwater contamination at this site because the clay horizon is sufficiently thick to protect any water in the underlying sandstone.

#### **GEORGE TOWN tip, Mount George**

##### *Status*

Current. This site was an old quarry for road material.

Wastes are scattered on the ground surface and remain unsealed. A narrow trench has been dug around the tip area to collect runoff water but it is partially filled with wastes which form dams, and water lies in the trench at many places.

##### *Geology (Beaconsfield sheet) and hydrogeology*

This landfill site is situated on a residual soil consisting of grits, pebbles and boulders of dolerite with a clay matrix. This soil is produced by the weathering of the underlying Jurassic dolerite, and represents a laterite surface. The depth to *in situ* unweathered dolerite is anticipated to be shallow (<10 metres) because big dolerite blocks were observed at the base of surrounding outcrops. The permeability of this soil is considered to be low to very low.

The depth to the Permian basement, consisting of siltstone and shale in the surrounding area, is unknown but it is expected to be deep (>50–100 m).

Both Jurassic dolerite and Permian siltstone may contain groundwater, but the hydrogeological characteristics

(fracturing density, depth to water table) are also unknown in this area.

Contamination of any groundwater in the dolerite may occur. Boreholes would be required to determine the thickness of the low permeability soil material because this soil might prevent leachate leaking to the underlying dolerite.

Management is poor at this site and should be improved to control any leachate which is produced.

#### **LEFROY tip**

##### *Status*

Current. Trench system (L:30, W:4, D:4 m). Domestic wastes are dumped into the trench but some scattered deposits were also observed on the surface. Old trenches have been sealed.

##### *Geology (Beaconsfield sheet) and hydrogeology*

Quartz gravel and angular pebbles with a clay matrix were observed in the trench. Some clay horizons with a few pebbles were also observed. The quartz pebble content varies rapidly both laterally and in profile. Some Tertiary age horizons, consisting of angular gravel, mainly of vein quartz with silt-clay matrix, are cemented. The permeability of this formation is expected to be low.

Basement rocks are expected to be Siluro-Devonian sandstone (Mathinna Beds). There may be a basalt flow between the Tertiary sediments and basement rocks. Depth to the water table in both the basalt and sandstone is unknown.

Groundwater contamination is not expected to occur at this site because of the low permeability of the Tertiary sediments in which the tip lies. It is a good landfill site and is well managed.

#### **LULWORTH tip**

##### *Status*

Current. Trench system (L:20, W:4, D:4 m), old trenches have been sealed but water was observed lying in the current trench.

##### *Geology (Pipers River sheet) and hydrogeology*

The following deposits were observed in the trench (from top to bottom): about one metre of fine-grained sand (light grey), 0.5 m of cemented fine-grained sand with a few clay horizons (brown), and then more than 2.5 m of sandy clay and clay. The percentage of clay increases towards the bottom of the trench.

The origin of the sand and clay is the same as at the Bellingham tip (see above). Similar conclusions can be made.

#### **PIPERS RIVER tip**

##### *Status*

Current. Trench system (L:20, W:4, D:4 m)

##### *Geology (Pipers River sheet) and hydrogeology*

High plasticity clay of very low permeability was observed in the trench. The clay is likely to be the product of the weathering of basalt. This landfill site is located near the boundary with Tertiary sediments so that clay from these deposits may also be represented.

Expected basement consists of Siluro-Devonian slate and phyllite (Mathinna Beds) but both the depth to the basement and the water level are unknown in these rocks.

There is potential for groundwater contamination at this site if the clay is of insufficient thickness to prevent leachate seeping to the underlying rocks. Further boreholes would be necessary to determine these unknown parameters.

**WEYMOUTH tip**

*Status*

Current. Trench system. Old trenches have been sealed with low permeability material.

*Geology (Pipers River sheet) and hydrogeology*

The following sediments were observed in the trench (from top to bottom): approximately 0.5 m of fine-grained sand (windblown sand) and then more than two metres of very low permeability clay. The clay is the product of the weathering of the underlying basalt. *In situ* basalt may be only a few metres below the bottom of the trench. Siluro-Devonian sandstone (Mathinna Beds) represents the basement. Both the basalt and sandstone formation may contain groundwater.

Clay layers at the bottom of the trench appear to be of sufficient thickness to prevent any groundwater contamination. Thus it is a good landfill site. The situation is very similar to that at the Bellingham and Lulworth tips.

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**MUNICIPALITY OF GLAMORGAN**

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**BICHENO tip**

*Status*

Current. Trench system (L:70, W:7, D:4 m). Management is good on this site, and trenches have been sealed with low permeability material. Car bodies and garden waste have been dumped on the land surface near the trenches.

*Geology (Oatlands sheet, only 1:250 000 available) and hydrogeology*

The following sediments were observed in the trench (from top to bottom): about one metre of very fine-grained sand (grey), probably a Quaternary windblown sand formation; clay with a few pebbles and boulders; and blocks of very weathered granite at the bottom of the trench.

The tip site is underlain by igneous rocks consisting of granite-adamellite (Lower Carboniferous–Upper Devonian). These rocks may contain groundwater but granite intrusions generally provide poor yields and the success rate of water bores is quite low.

There is a slight potential of groundwater contamination within the granite.

**COLES BAY tip**

*Status*

Current. Trench system (L:50, W:10, D:5 m). Old trenches have been sealed with sand.

*Geology (Oatlands sheet, only 1:250 000 available) and hydrogeology*

Fine-grained sand (grey) with a few horizons of pebbles, probably a Quaternary windblown sand and alluvial

formation, occur in the trench. The permeability is moderate. Granitic rocks are expected to form the basement and they may lie less than 10 m below the bottom of the trench.

Both the sand formation and the granitic rocks may contain groundwater but water levels are unknown. Thus groundwater contamination may be anticipated within these rocks. The sand is probably of very limited lateral extent so that any pollution would be confined to the surrounding area. Moreover there is unlikely to be significant potential for groundwater contamination within the basement granitic rocks.

Management could be easily improved on this site by sealing the trenches with low permeability material after filling.

**SWANSEA tip, Marla Street**

*Status*

Current. Trench system (L:30, W:5, D:3 m). Old trenches have been sealed. Tree branches and car bodies have been dumped on the ground surface alongside the trenches.

*Geology (Oatlands sheet, only 1:250 000 available) and hydrogeology*

Clay produced from the weathering of dolerite, and blocks and fragments of Jurassic dolerite were observed in the trench. *In situ* rock probably occurs at the bottom of the trench. The dolerite is medium grained.

The permeability of the weathered dolerite is expected to be low, depending partly on the fracture density in the fresh rock. Dolerite may be a good aquifer with a water bore success rate of greater than 50%.

The depth to the water table is unknown but it is anticipated to be quite deep (probably >20 m) due to the location of this site.

There is a potential for groundwater contamination at this site due to the shallow depth of the dolerite. However weathered material (mainly clay) and the significant depth to the water table might reduce the downward infiltration of leachate. Further investigations would need to be undertaken to determine the hydrogeological parameters.

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**MUNICIPALITY OF GLENORCHY**

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**GLENORCHY tip**

*Status*

This tip site is extensive and may be divided into two sectors. The current operation occurs in the new zone, whereas the old area has been closed after sealing of wastes.

Wastes have been placed on the ground surface (past and current operation) and sealed. However management could be improved because several ponds (leachate) have been observed on the old site and empty barrels of oil (aviation fuel) have been dumped on the new part. Part of the tip site may have been an old quarry for road material (dolerite).

*Geology (Hobart sheet) and hydrogeology*

The closed sector is likely to be underlain by Jurassic dolerite. It is not currently possible to observe the contact between wastes and rock. However wastes have probably been placed on slightly weathered dolerite (as at new sector) so that there is obviously no clay layer to prevent downward migration of

leachate. The permeability of the dolerite is expected to be low but it may be greatly increased by a high fracture density.

The Jurassic dolerite may also contain groundwater but the level to the water table is expected to be deep (>20 m) due to the location of this site on a hillside.

The new sector may lie on the boundary between Jurassic dolerite and Permian mudstone (Cascades Group). However it is expected that most of the wastes are underlain by mudstone. This formation may contain groundwater and its permeability depends greatly on the jointing and fracture density. The water table is also anticipated to be deep due to the tip's location.

There is a potential for groundwater contamination within both the Permian mudstone and the Jurassic dolerite. However this risk is expected to be small due to the significant depth to the water table.

Further information would be necessary to determine precisely the potential for groundwater contamination, and monitoring should be undertaken on this site. Special care should be taken with landfill sites covering a large area.

The management should be improved with respect to leachate ponds, and disposal of barrels which contained hydrocarbons (hazardous wastes) must be forbidden in an area for domestic wastes because of the risk of groundwater contamination (very small quantities of hydrocarbons can contaminate significant volumes of water).

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**MUNICIPALITY OF HAMILTON**

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**BRONTE LAGOON tip**

*Status*

Current. Trench system (L:20, W:3, D:3 m). A drain has been dug to allow leachate and stormwater to run out of the trench but it is blocked by wastes. Old trenches have been sealed with low permeability material.

*Geology (St Clair sheet) and hydrogeology*

Clay and pebbly clay, probably the weathering product of the underlying dolerite, were exposed in the trench. *In situ* fresh dolerite is expected to occur only a couple of metres below the bottom of the trench, as weathered blocks of dolerite were observed.

The permeability of the clay is low to very low but it is moderate within the slightly weathered rock. Jurassic dolerite may contain groundwater, and the level of the water table is expected to be shallow on this site.

There is a potential for contamination of groundwater within the dolerite because any clay horizon which could have prevented leachate infiltration has been stripped away when the trenches were dug. It would preferable to dump wastes on the ground surface and to seal them with low permeability material (clay). This would avoid the removal of the only protection horizon (clay produced by dolerite weathering).

**BRONTE PARK tip**

*Status*

Closed, probably recently. It is expected that the operation used a trench system on this site. All trenches have been sealed.

*Geology (St Clair sheet) and hydrogeology*

The tip site is surrounded by outcrops of dolerite, so that it is expected that Jurassic dolerite underlies the site. The geological setting is likely to be very similar to the Bronte Lagoon tip. However the depth to the water table is probably greater on this site because of its location on a hill.

Comments and remarks made for the Bronte Lagoon tip are likely to apply to this site, although the potential for groundwater contamination is expected to be less significant because of the depth to the water table.

**DERWENT BRIDGE tip**

*Status*

Current. Trench system (L:50, W:3, D:2m). Old trenches have been sealed with low permeability material consisting of clay and silt.

*Geology (St Clair sheet) and hydrogeology*

Gravel, pebbles and cobbles in a silt matrix were observed in the trench. The matrix material is very abundant, so that the permeability is expected to be moderate to low.

These deposits may be a Quaternary fluvio-glacial formation or till. The thickness of this formation is expected to be greater than 10 m and it may be relatively porous. The level of the water table in this aquifer is probably similar to the water level in Lake King William (i.e. at shallow depth), as this tip lies along the lake's shore.

Basement rock is probably Jurassic dolerite which may contain groundwater. The level to the water table is unknown.

There is a potential for contamination of groundwater in the Quaternary material. Further investigation would be necessary for a better understanding of the situation in the dolerite because the potential for pollution will depend on both the thickness of the weathered horizon (clay) and the fracture density.

**GRETNA tip**

*Status*

Current. Trench system (L:50, W:4, D:3 m). Old trenches have been sealed, probably with sand material.

*Geology (Oatlands sheet, only 1:250 000 available) and hydrogeology*

Approximately one metre of fine-grained sand (grey) underlain by very weathered siltstone and sandstone were observed in the trench. Fluvio-lacustrine sandstone and siltstone sequences of Triassic age (Upper Parmeener Supergroup) are also present. The permeability of these rocks is anticipated to be moderate.

The sandstone is expected to be underlain by Permian and Upper Carboniferous sequences of pebbly mudstone and pebbly sandstone (Lower Parmeener Supergroup). All of these formations may contain groundwater but their thickness, as well as the level of the water table, are unknown.

The potential for groundwater contamination within the sandstone aquifer is significant, whereas it is very slight within the underlying formation which consists mainly of mudstone.

**HAMILTON tip**

*Status*

Current. This tip site is an old quarry for road material. Thus, wastes have been dumped on the ground surface and the operation consists of the filling of this quarry.

*Geology (Oatlands sheet, only 1:250 000 available) and hydrogeology*

The site is partly surrounded by outcrops (cliffs about 20 m high) of Jurassic dolerite. These rocks are weathered and the fracture density seems to be very high. The tip site is obviously underlain by Jurassic dolerite, and this formation is expected to have potential to be a fractured aquifer.

There is potential for groundwater contamination within the dolerite on this site because it is expected that wastes have been dumped on the fresh (or slightly weathered) rock. At the top of the cliff, the clay layer produced by the weathering of dolerite is very thin (<1 m) so that it is probably not sufficient to prevent infiltration of stormwater and leachate.

**OUSE tip**

*Status*

Current. Trench system (L:80, W:4, D:3 m). Old trenches have been sealed with low permeability material. Operational trench is drained to prevent leachate accumulating.

*Geology (Oatlands sheet, only 1:250 000 available) and hydrogeology*

Clay and silt (brown-beige) with a few pebbles, mainly angular, were observed in the trench. These sediments are probably non-marine sequences of Tertiary age (interbedded with basalt?). The permeability of this formation is low to very low, and its thickness is expected to be quite large (>10 m). These sediments are underlain by Jurassic dolerite which may contain groundwater in fractures.

There is unlikely to be significant groundwater contamination on this site because of the low permeability of the Tertiary sediments, which are expected to prevent leachate seeping downwards to the dolerite.

Management of this landfill area is good.

**TARRALEAH tip**

*Status*

Current. Trench system (about 2 m deep). The trench is open-ended with a drain which should allow leachate and stormwater to flow out but it has been filled with wastes and water was observed lying in the trench and drain.

*Geology (St Clair sheet) and hydrogeology*

About one metre of very weathered dolerite (clay with fragments of rocks) overlies *in situ* slightly weathered rock in the trench.

This geological setting is very similar to that at the Bronte Lagoon tip, so that the same remarks and conclusion can be given for this landfill site. Thus there is a potential for groundwater contamination within the dolerite.

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**MUNICIPALITY OF HOBART**

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**HOBART tip**

*Status*

Current. Wastes are dumped on the ground surface and the operation consists of the filling of a valley. Wastes have been sealed after placement.

*Geology (Hobart sheet) and hydrogeology*

The site is underlain by Permian rocks consisting mainly of quartz siltstone and sandstone (Malbina Formation). The permeability of this formation is expected to be low to moderate but it may be increased by close fracturing. Several main faults cross the area so that it may be anticipated that the degree of fracturing is significant.

Some cliff outcrops of Jurassic dolerite have been observed on the eastern side of the valley but it is not expected that wastes are in contact with this formation.

The level of the water table within the fractured Permian rocks is unknown.

There is potential for groundwater contamination within the Permian rocks. However further investigation and monitoring should be carried out on this site to determine unknown hydrogeological parameters. As at the Glenorchy tip, this site is very extensive so that special care should be taken to ensure groundwater contamination is not significant.

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**MUNICIPALITY OF HUON**

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**HUONVILLE tip, South Bridge**

*Status*

Current. Wastes are dumped on ground bordering the Huon River and partially covered with earth. They are packed down and form a bank very close to the rivers edge.

*Geology (Kingborough sheet) and hydrogeology*

Some outcrops were noted in the surrounding area and they consist of sand, gravel and pebbles in a silt-clay matrix. These Quaternary fluvio-alluvial deposits are considered to be of moderate to low permeability, and probably take the form of a multi-level aquifer.

The underlying formation is dolerite, and this rock crops out in the surrounding area.

There is the potential for contamination of water within the surface Quaternary deposits and also in the underlying dolerite, depending on the depth to the bedrock and the jointing density. Contamination of the river with leachate is likely.

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**MUNICIPALITY OF KENTISH**

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**RAILTON tip**

*Status*

Current. Trench system (L:30, W:3, D:3 m). Water was observed lying in the trench, which was half full.

### *Geology (Sheffield sheet) and hydrogeology*

Sediments observed in the trench consisted of clay and pebbly clay of low permeability. These Quaternary deposits are probably underlain by both Ordovician sandstone (Moina Beds) and Permian shale.

Depth to basement rocks and water level in this formation are both unknown.

Groundwater contamination at this landfill site does not seem to be a problem although management should be greatly improved.

### **SHEFFIELD tip, off Victoria Street**

#### *Status*

Current. Trench system (L:10, W:2, D:2m). Old trenches have been sealed with low permeability material.

#### *Geology (Sheffield sheet) and hydrogeology*

Tertiary sediments, consisting mainly of clay and some horizons of pebbles in a clay matrix, were observed in the trench. The average permeability is expected to be very low. Some boreholes in the surrounding region have shown that the thickness of these Tertiary sediments may be approximately 50 metres. They are underlain by a sequence consisting of basalt flows interbedded with both gravel and sand (>50 m deep).

Basement rocks (Cambrian or Ordovician) may thus be very deep (>100 m).

There is not likely to be any groundwater contamination on this site. The large thickness of Tertiary sediments of low permeability provides an effective barrier to the downward migration of leachate.

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## **MUNICIPALITY OF KINGBOROUGH**

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### **MARGATE tip — Margate-Baretta**

#### *Status*

Current. Wastes are deposited in an old quarry and are partially covered. Leachates are drained under the landfill site and collected in a pond. Stormwater is also collected to prevent infiltration through wastes generating more leachate.

#### *Geology (Kingborough sheet) and hydrogeology*

The tip is partially surrounded by outcrops of fine-grained sandstone and mudstone of likely Triassic age. However the site may be underlain by Tertiary silicstone (silcrete), which was used as road material.

The thickness of this silicstone formation may be very small and Triassic sandstone is expected to occur at shallow depth on this site, and it may be in contact with wastes in some places. There is a potential for contamination of groundwater in the Triassic sandstone on this site but it will depend on both the depth to the water table and the fracture density of this formation.

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## **MUNICIPALITY OF LAUNCESTON**

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### **LAUNCESTON tip, Remount Road, Mowbray**

#### *Status*

Current, in use for 5 years, expansion is quicker than expected. Wastes are dumped on the land surface and fill a small valley. They are sealed with low permeability material after being deposited. Stormwater is diverted by a trench which surrounds the tip area, and leachate is collected by a drain network underneath and pumped to a sewage treatment plant.

#### *Geology (Launceston sheet) and hydrogeology*

A geological investigation was undertaken for the project in 1983. Results of this investigation and on the feasibility of the project are presented in Tasmania Department of Mines unpublished report 1983/23, by A. T. Moon. The tip site is underlain by Tertiary sediments and Jurassic dolerite. The most important observation of the subsurface investigation was the presence of a clay horizon throughout the site. This horizon, of very low permeability, is expected to provide an effective barrier to the downward migration of leachate or the upward flow of groundwater from more permeable underlying material. The clay horizon divides 'perched groundwater' from 'confined groundwater'.

The good management observed at this site should prevent any significant contamination. The clay horizon must be left intact so that leachate will be mainly confined to the perched near-surface and local aquifer. There is unlikely to be significant groundwater contamination of the dolerite aquifer.

Monitoring should be carried out to determine whether any groundwater contamination occurs on this site.

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## **MUNICIPALITY OF LILYDALE**

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### **KARoola tip, Second River Road (Lalla)**

#### *Status*

Current. Trench system (L:20, W:10, D:3 m). Operation and management are similar to the Nabowla and Wyena tips.

#### *Geology (Pipers River sheet) and hydrogeology*

Mudstone, with a few horizons of pebbles/boulders, and weathered sandstone were observed in the trench. These deposits are Permian-age sediments, and their permeability is anticipated to be low. However the Permian rocks can be good fractured aquifers, and bores in them have a fairly high success rate.

Basement rocks are expected to be Siluro-Devonian siltstone and sandstone (Mathinna Beds) but the depth to the basement is not known, nor is the level of the water table.

There is obviously no groundwater contamination on this landfill site due to the significant thickness of the weathering of bedrock to clay and sandy clay. The tip area is well managed.

### **NABOWLA tip, Bridport Back Road**

#### *Status*

Current. Trench system (L:20, W:5, L:5 m). There is a slight slope on the bottom of the trench and a narrow outlet drains leachate and stormwater from the trench. Old trenches have been sealed.

*Geology (Pipers River sheet) and hydrogeology*

Very weathered Siluro-Devonian siltstone and mudstone (Mathinna Beds) were observed in the trench. The weathering has produced clay so that the permeability of this horizon is very low. Unweathered rock may be present a few metres below the bottom of the trench. The basement rocks usually have a low permeability which may be increased by fracturing and high joint density. Bores in the Mathinna Beds have a fairly high success rate and provide significant yields.

There is probably no groundwater contamination at this tip site due to the barrier formed by clay. This is expected to prevent leachate infiltration.

**WYENA tip, Golconda Road**

*Status*

Current. Trench system (L:20, W:10, D:5 m). Operation and management are similar to the Nabowla tip (see above).

*Geology (Pipers River sheet) and hydrogeology*

Weathered mudstone and siltstone with some horizons of black slate were observed in the trench (Mathinna Beds).

The permeability of this formation is expected to be low but these Siluro-Devonian rocks may become more permeable at depth if joints and fractures become more common and are interconnected.

There is unlikely to be significant groundwater contamination at this site because of the very low permeability of the weathered rock (clay).

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**MUNICIPALITY OF LONGFORD**

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**LONGFORD tip**

*Status*

Current, in use for 6 years, 2 years of use remaining. Trench system (about 5 m deep). Old trenches have been sealed.

*Geology (Longford sheet) and hydrogeology*

Gravel and pebbles in a silt matrix were observed in the trench. These Quaternary river terrace deposits are quite homogeneous, with a moderate permeability.

The level of the water table is less than one metre below the bottom of the trench, however this aquifer may be local in lateral extent.

Existing boreholes, located about one kilometre from the tip, show that the thickness of these deposits is less than 10 m and that they are underlain by very thick Tertiary sediments (mainly lacustrine clay). Thus the depth to the basement, probably Permian mudstone (Ferntree Mudstone) or dolerite, is large.

There is obviously groundwater contamination of the Quaternary material at this site but this pollution may be confined to the surrounding area due to the probable local extent of this material.

The Tertiary sediments provide an effective barrier to downward infiltration of polluted water.

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**MUNICIPALITY OF LYELL**

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**QUEENSTOWN tip, Lynchford Road**

*Status*

Current. This site lies along the banks of the Queen River. In the past, wastes were dumped on the ground very close to the river, and some car bodies etc. were observed lying in the river. Empty barrels which contained oil, petrol and toxic products used for copper treatment were also observed on the site. These wastes have been partly sealed and the surface is tarred. The current operations use a trench system further from the river (about 50 m).

*Geology (Lyell sheet) and hydrogeology*

The site is probably underlain by both alluvium (mainly for the old operation) and Pleistocene till, commonly with dolerite boulders (observed in the trench). The permeability is moderate to high within the Quaternary alluvium, and is expected to be moderate to low in the till. The thickness of these two formations is likely to be about 10 metres.

The alluvium is likely to contain groundwater and the level of the water table may be very similar to the level of the Queen River.

Basement rocks are difficult to define precisely because of the complex geology in the surrounding region and the countless faults. However it is expected that basement consists of either Siluro-Devonian mudstone (Eldon Group) or Cambrian-Ordovician rocks. All of the expected basement rocks may contain groundwater.

There is a significant potential for both surface and groundwater contamination at this tip site. The Queen River is probably contaminated downstream by leachate flowing out from the tip (and also from the copper treatment plant). Groundwater contamination obviously occurs within the Quaternary alluvium. However the lateral extent of this formation is small, so that pollution may be confined to the surrounding area.

Further investigations should be undertaken to precisely define the potential for groundwater contamination within the basement rocks. Too many hydrogeological parameters are presently unknown to assess this potential.

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**MUNICIPALITY OF NEW NORFOLK**

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**NEW NORFOLK tip, Peppermint Hill**

*Status*

Current. Wastes have been dumped on the ground surface and have been partly sealed.

*Geology (Hobart sheet) and hydrogeology*

The tip site lies on Permian age unfossiliferous quartz siltstone (Ferntree Group). This formation may contain groundwater but the depth to the water table is unknown. However because of the high location (hill) of the landfill area, the water table is anticipated to be very deep.

There is a small potential for groundwater contamination within the Permian rocks at this tip site. However contact between wastes and siltstone has not been observed so that it is not possible to give precise information. Further investigation would be necessary to improve the understanding of the site.

**MUNICIPALITY OF PENGUIN**

**PENGUIN tip, Ironcliffe Road**

*Status*

Current. Trench system, but very scattered operation. The site is probably an old quarry. Drainage is not controlled and surface runoff was observed entering the trench.

*Geology (Devonport sheet) and hydrogeology*

Clay and silty clay were observed in the trench; these are probably Tertiary deposits. Some sandstone outcrops occur in the surrounding area, these probably belonging to the Moina Sandstone formation (Ordovician) and representing the basement. Sandstone is expected to be at very shallow depth below the bottom of the trench. The Ordovician sandstone may contain groundwater but the depth to the water table is unknown.

There is a small potential for groundwater contamination at this site, depending mainly on the thickness of Tertiary clay and the depth to the water table in the sandstone. Monitoring should be undertaken to determine whether leachate is infiltrating to the basement rocks.

**MUNICIPALITY OF PORT CYGNET**

**CYGNET tip, Tobys Hill Road**

*Status*

Current. Wastes are dumped on the ground surface and fill a small valley.

*Geology (Kingborough sheet) and hydrogeology*

The site is underlain by mudstone and tillite of Permian age (Truro Tillite). The permeability of this formation is expected to be low but it may contain some groundwater.

Because of the poor outcrop at this site it is difficult to assess the potential for groundwater contamination.

There are quite a few successful water bores in the Permian rocks in the Cygnet area, some giving yields of several thousand gallons per hour. If the mudstone and/or tillite is weathered to a clay at the surface the risk of contamination is probably small.

**MUNICIPALITY OF PORTLAND**

**WELDBOROUGH tip**

*Status*

Current. Trench system (L:20, W:4, D:3 m). Old trenches have been sealed.

*Geology (Launceston sheet, only 1:250 000 available) and hydrogeology*

Clay material was observed in the trench, with some blocks of slightly weathered granite at the bottom. The basement rocks consist of a Lower Carboniferous–Upper Devonian intrusion of granite-adamellite. These igneous rocks may contain some groundwater but the success rate of water bores in these rock types is quite low (20%).

There is probably no problem of groundwater contamination at this site as it is well managed.

**MUNICIPALITY OF RINGAROOMA**

**BRANXHOLM TIP**

*Status*

Current. Wastes are dumped in a small valley and are not sealed.

*Geology (Ringarooma sheet) and hydrogeology*

The site is underlain by granitic rocks consisting of equigranular, fine to coarse-grained granite/adamellite (Blue Tier Batholith). It is possible that a small part of the wastes lie on Mathinna Beds (Devonian-Silurian) because of the proximity of this formation. Both Mathinna Beds sediments and the granitic intrusion may contain groundwater in fractures but the depth to the water table is not known.

There is likely to be little potential of groundwater contamination at this site. The water table is expected to be deep. However management should be improved so that the generation of leachate in the waste mass is prevented. There is a potential for surface water pollution because of the proximity of the river.

**DERBY TIP**

*Status*

Current. Trench system (L:10, W:3, D:2m). Old trenches have been sealed, mainly with sandy material. The site lies along the Ringarooma River.

*Geology (Ringarooma sheet) and hydrogeology*

Horizons of gravel, sand and conglomerate (with a sand matrix) were observed in the trench. The permeability of this Quaternary river terrace formation is considered to be high. The thickness of these sediments may be about 10 m and they are probably underlain by contact metamorphosed psammite (Mathinna Beds) which represents the basement, and may be a good fractured aquifer.

There is a potential for groundwater contamination on this site in both the Quaternary deposit and the basement rocks. The level of the water table in the sand aquifer is probably similar to the water level in the Ringarooma River. Downward migration of stormwater and leachate can be expected because no low permeability material was observed. Monitoring should be carried out on this landfill site to assess the lateral extent of groundwater contamination within the Quaternary material, and to determine if water in the basement rocks is also polluted.

The trenches should be sealed with low permeability material (clay) instead of sand to prevent stormwater infiltrating into the trenches.

**GLADSTONE tip**

*Status*

Current. This landfill has been developed by placement of garbage in a small valley. The site may have been an old quarry. Wastes are not covered.

*Geology (Eddystone sheet) and hydrogeology*

This site is expected to be underlain by a Devonian quartzwacke turbidite sequence (Mathinna Beds). Some outcrops have been observed very close to the tip and *in situ* rocks lie about one metre below the surface. Contact

metamorphism occurs in the region. The tip area is surrounded by Tertiary sediments, consisting of gravel, sand and clay, overlying basement.

No hydrogeological information is available for this site, but the Mathinna Beds are considered to be a good aquifer.

There is potential for contamination of groundwater in the Devonian rocks. However knowledge of many parameters would be necessary for a better understanding of this potential. It would have been preferable to dump wastes in trenches dug in the Tertiary sediments because they would provide an effective barrier against downward infiltration of leachate.

**LEGERWOOD tip**

*Status*

Current. Wastes are deposited on the ground surface and they fill a small valley. Wastes are partly sealed with earth.

*Geology (Ringarooma sheet) and hydrogeology*

The tip site is underlain by contact metamorphosed psammite and pelite of Siluro-Devonian age (Mathinna Beds). These rocks have been metamorphosed by a major granitic intrusion of Upper Devonian-Lower Carboniferous age. Outcrops of granite have been observed very close to the tip (<50 m).

The Mathinna Beds may contain groundwater.

This is probably not a good tip site but it is not expected that serious groundwater contamination will occur. However there is a potential for surface water contamination.

**PIONEER Tip**

*Status*

Current. Wastes are dumped on the ground surface and not sealed. Scattered deposits occur over all the landfill site.

*Geology (Ringarooma sheet) and hydrogeology*

The tip site is underlain by Tertiary sediments consisting of gravel, sand, clay and mud. The average permeability is expected to be low. Some outcrops of porphyritic granite/adamellite (basement) were observed in the surrounding area but the depth below the landfill site is unknown.

There is little potential for groundwater contamination on this site but there may be a problem for surface water due to the very poor management of the site.

**RINGAROOMA Tip**

*Status*

Current. Trench system (about 5 m deep).

*Geology (Ringarooma sheet) and hydrogeology*

Clay and very weathered sandstone were observed in the trench and unweathered sandstone occurs at the bottom of the trench. The permeability varies in profile from low in clay horizons to moderate in weathered sandstone.

The Devonian sandstone (Mathinna Beds) may contain groundwater but the depth to the water table is unknown.

There is a very slight potential for groundwater contamination in the sandstone beds at this site but surface water pollution may occur.

**TOMAHAWK Tip**

*Status*

Current. Trench system (about 3 m deep). Old trenches have been sealed.

*Geology (Boobyalla sheet) and hydrogeology*

Very fine sand (grey) was observed in the trench. This is probably a younger aeolian sand dune and beach sand deposit (Quaternary). The permeability of this formation is expected to be moderate. Sand dune aquifers may provide very good quality fresh water. The depth to the water level and the thickness of this formation are unknown.

Outcrops of porphyritic granite/adamellite (Blue Tier batholith) were seen in the surrounding areas, so that the depth to the basement is expected to be small.

There is potential for groundwater contamination within the sand aquifer due to the anticipated shallow depth to the water table. However contamination of any groundwater in the fractured granite is not expected. The trench should be sealed with a low permeability material instead of sand.

**WINNALEAH tip**

*Status*

Current. Trench system (L:20, W:5, D:3 m). A slight slope at the bottom of the trench and a small drain allows leachate to flow out. Old trenches have been sealed.

*Geology (Ringarooma sheet) and hydrogeology*

The trench has been dug in slightly weathered granite. Slightly weathered porphyritic granite/adamellite was observed at the bottom of the trench.

The top material (weathered rock) has a high to very high permeability (grit without matrix) but the permeability is expected to be lower in the basement. All of these igneous rocks may contain groundwater but the success rate of water bores is low and the bores provide only small yields.

There is not likely to be much potential for groundwater contamination on this site but it would be better to seal the trenches with low permeability material instead of weathered granite of high permeability. This would prevent stormwater entering the trenches and generating leachate.

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**MUNICIPALITY OF SCOTTSDALE**

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**BRIDPORT tip**

*Status*

Current. Wastes are dumped on the ground surface and fill a small valley. They form a high bank (about 15 m thick) and are not sealed. Deposits are scattered on the landfill site.

*Geology (Pipers River sheet) and hydrogeology*

This site is probably underlain by Quaternary windblown sand. The permeability of this deposit is expected to be moderate.

The basement consists of Siluro-Devonian siltstone and mudstone (Mathinna Beds) and its depth is anticipated to be shallow because many outcrops were observed in the surrounding areas. Both the Quaternary formation and the Mathinna Beds may contain groundwater.

There is a potential for the contamination of groundwater in both the surface sand and the underlying sandstone. This is not a good landfill site and the management is poor.

**SCOTTSDALE tip**

*Status*

Current. Wastes are dumped on the ground surface and fill a small valley. They form a 10 m thick bank and are partially sealed.

*Geology (Pipers River sheet) and hydrogeology*

This site is located on Tertiary sandstone (observed in a nearby quarry) which is likely to be underlain by a basalt flow (Tertiary). The permeability of the fine to very coarse-grained sandstone is expected to be moderate.

The basement is anticipated to be a Devonian granodiorite intrusion.

Further information would be necessary to know if there is contamination of water in any of several possible rock types at this site. Monitoring should be undertaken to determine this.

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**MUNICIPALITY OF SPRING BAY**

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**BUCKLAND tip, Sally Peak Road**

*Status*

Current. At present, a trench system (L:30, W:6, D:3 m) is used at this site. In the past wastes were dumped on the ground surface, but they have been sealed and now form a bank on the landfill site.

*Geology (Buckland sheet) and hydrogeology*

About one metre of fine-grained sand (light to dark grey) is underlain by weathered sandstone in the trench. The permeability of these materials is expected to be moderate.

Unweathered Triassic sandstone (Ross and Knocklofty Sandstones) is anticipated to occur at the bottom of the trench or a few metres underneath. Triassic sandstone is usually a good aquifer and the depth to the water table is probably shallow.

There is a significant potential for contamination of groundwater within the Triassic sandstone.

**ORFORD tip, off Tasman Highway**

*Status*

Current. This tip has been in use for than 15 years. Wastes have been dumped on the ground surface and they are mainly sealed. This site was developed by the filling of a small valley.

*Geology (Buckland sheet) and hydrogeology*

The site is obviously underlain by Triassic sandstone and shale. However outcrops of sand and gravel (river terrace deposits?) were observed around the tip site. They may be a few metres thick and might be present under wastes

throughout the tip site. The Triassic sandstone may be a good aquifer.

There is a significant potential for groundwater pollution on this site. As the Triassic rocks are favourable for the installation of water bores, and soils developed on them can be quite permeable, the risk of leachate reaching the water table is very high. Leachate may easily infiltrate downwards to the sandstone aquifer because the overlying Quaternary material, consisting of sand and gravel, is too permeable to prevent leachate movement.

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**MUNICIPALITY OF STRAHAN**

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**STRAHAN tip, Ocean Beach Road**

*Status*

Current. Trench system (L:50, W:50, D:2 m). Old trenches have been sealed.

*Geology (Strahan sheet) and hydrogeology*

Important lateral variations were observed in the operational trench. Very fine-grained sand (grey), probably a sand dune formation (windblown sand), was observed in one part although pebbles and cobbles in a silt-sand matrix occur in a second part. Outcrops of this latter material were observed in the surrounding area, and it is thought to be a Tertiary conglomerate. This rock is slightly cemented, at least on the surface.

The site may lie on the boundary between Quaternary sand dunes, which are very common in the surrounding region, and Tertiary sediments. The permeability of these two formations is anticipated to be moderate to high, and they probably contain groundwater. However the depth to the water table is not known for either formation.

Basement rocks may be either Permian mudstone (Parmeener Supergroup) or Devonian interbedded sandstone and mudstone (Eldon Group). These rocks may contain groundwater.

There is a significant potential for groundwater contamination within the sand dune material. The lateral extent of this formation is very wide in the surrounding region so that pollution could be very widespread. Sand dune aquifers may provide very good quality water for water supplies. A lower potential for groundwater contamination is present for the other formations (basement and Tertiary sediments).

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**MUNICIPALITY OF ULVERSTONE**

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**ULVERSTONE tip**

*Status*

Current. In use for 13 years. Wastes have been dumped adjacent to the Leven River after a narrow bank (3 m high) was built to prevent them falling into the river. The tip site is divided into sections which are sealed after each part is filled.

*Geology (Devonport sheet) and hydrogeology*

The site lies on Quaternary alluvium consisting of gravel and sand with a silty matrix. The permeability of this formation is expected to be moderate to low, and its thickness is likely to be less than 10 metres. This formation may contain groundwater but its lateral extent is very limited.

Basement rocks are anticipated to be of Cambrian age (Kerrison Volcanics?) and may contain groundwater. The

depth to the water table is unknown. Further investigations would be necessary to determine this depth, and to gain a better understanding of the hydrogeological setting.

There is obviously groundwater contamination within the surface Quaternary alluvial material but it may be very confined due to the limited extent, both vertically and laterally, of this material. There is also a significant potential for groundwater contamination within the underlying Cambrian rocks because of the small depth to the basement (<10 m) and the permeability of the overlying material.

Surface water contamination may be expected on this site because of the proximity of the Leven River.

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### MUNICIPALITY OF WYNYARD

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#### WYNYARD tip, between Gibbons Street and Inglis River

##### *Status*

Current. Waste is dumped on the ground surface and in a trench and partially covered.

##### *Geology (Table Cape sheet) and hydrogeology*

The tip area is underlain by Quaternary sand at the surface with tillite, pebbly mudstone and mudstone of Permian age at depth.

The surface sand is expected to have a moderate permeability. The Permian rocks weather to clay, which will have moderate permeability where it is jointed and has distinct bedding planes.

Leachate from the wastes could migrate through the surface sand, and where the wastes are in contact with relatively fresh rock, infiltration to any groundwater in the Permian rocks is a distinct possibility.

Because the area is flat and low lying, the water table can be expected to be at only a few metres below the surface. Water occurs in the base of a trench near to the river.

There is potential for groundwater pollution from the tip but because of its location, it is unlikely to affect a large area. Significant pollution of the river is possible.

#### YOLLA tip

##### *Status*

Current. Wastes have been dumped on the ground surface and there are a lot of scattered deposits throughout the tip site. Wastes have been partly sealed. There is a trench around the landfill site to collect run-off water.

##### *Geology (Burnie sheet) and hydrogeology*

The site is underlain by basalt or basalt talus. The expected depth to fresh rock is only a couple of metres but there is probably a clay horizon between the wastes and basalt. This low permeability layer would have been produced by the weathering of Tertiary basalt. Basalt is usually a good aquifer (vesicles and fractures) but the level of the water table is unknown on this site.

There is a slight potential for groundwater contamination within the basalt but further investigation would be necessary to determine whether the clay horizon is of sufficient thickness to prevent leachate infiltration to the underlying rock.

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### MUNICIPALITY OF ZEEHAN

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#### ROSEBERY tip

##### *Status*

Current. Wastes have been dumped on the ground surface and the operation involves placement of rubbish in a small valley.

##### *Geology (Zeehan sheet) and hydrogeology*

Gravel and boulders in a silt-clay matrix were observed in the surrounding excavations. All fragments are rounded and many consist of weathered sandstone. This formation probably has a fluvio-glacial origin (rounded fragments and structure), and the clay matrix may be the product of weathering after deposition.

The permeability of this Quaternary formation is expected to be low. According to the geological map, this deposit is a Pleistocene moraine.

The expected basement rock is the Cambrian Crimson Creek Formation. The depth to the water table in this formation is anticipated to be large.

There is unlikely to be any groundwater contamination at this site. However management is not good and it could lead to surface water contamination, as a tributary of the Pieman River lies very close to the tip site.

#### TULLAH tip

##### *Status*

Current. Trench system (L:30, W:4, D:3 m). The operational trench is drained to prevent leachate and stormwater lying in the trench.

##### *Geology (Mackintosh sheet) and hydrogeology*

Gravel, boulders and a few blocks in a sand matrix were observed in the trench. The permeability of this Quaternary fluvio-glacial material is expected to be moderate to high. Some horizons have been cemented.

The thickness of these deposits is probably about ten metres but their lateral extent is very limited.

The basement rocks consist of igneous rocks (quartz and quartz-feldspar porphyries) of Cambrian age. The Cambrian rocks may contain groundwater if they are sufficiently fractured. The water bore success rate is very high but yields obtained are quite low.

The depth to the water table in this formation is expected to be very deep.

There is a significant potential for groundwater contamination within the Quaternary material but pollution may be confined to the surrounding area because of the limited extent of this formation.

There is unlikely to be significant pollution of groundwater in the Cambrian rocks because of the probable large depth to the water table.

[5 April 1990]