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Preface

An important planning consideration for increased residential development in rural areas, is the ability or otherwise of soils to be used as an effective medium for the disposal and treatment of domestic liquid waste. Land resource mapping projects which assess the capability of land for rural-residential purposes must address tis topic for each land mapping unit.

The following report discusses on-site septic tank effluent disposal, the soil and land characteristics which affect or are affected by that land use, and proposes a method whereby land capability can be assessed for mapping units. The system was derived for soils of the Darling Range and Swan Coastal Plain near Perth, however the principles employed, and perhaps the class limits, should allow it to be used more extensively as an interpretive tool for soil or land resource surveys in other areas.

This report arises from the Darling Range Rural Land Capability Study. Financial assistance to that study by the national Soil Conservation Programme is gratefully acknowledged.

1. Introduction

1.1 Defining the Land Use

The conventional system for on—site disposal and treatment of domestic liquid waste consists of one or more septic tank units followed by a subsurface soil absorption system (Figure 1). The septic tanks act as a settling chamber for heavier material and also contain anaerobic bacteria which digest or breakdown the waste solids. After the bulk of solids have settled the remaining liquid or effluent passes from the tanks into the soil absorption system.

The soil absorption system may consist of one or more leach drains or, in deep sandy soils, two soak wells. The process for both absorption systems is the same. Effluent soaks into the ground and soil filters out any remaining fine solids and bacterial contaminants. Van de Graaff et al.(1980) report that transpiration by vegetation on absorption fields also plays a significant role. In most systems both absorption and transpiration processes take place concurrently with effluent dispersing mainly through interflow during wet periods and through evapotranspiration during dry periods (Brouwer et al.1979).

Soil absorption systems with leach drains or soak wells installed in a parallel arrangement are also used in some areas. In such a system a special diversion box is installed so that the flow of effluent can be directed to one area whilst ‘resting the other.

Successful functioning of the system is only achieved if the surrounding soil absorbs the volume of effluent produced and if it is purified by the processes of filtration, absorption and oxidation which occur as effluent moves through soil pores.

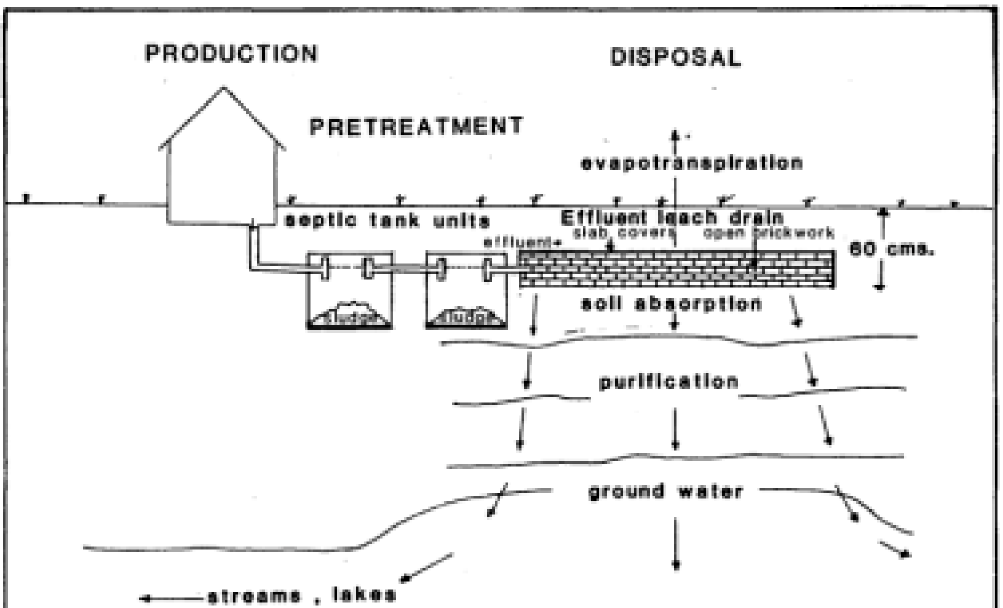


FIG.1 Schematic cross section through a conventional septic – tank soil disposal system for on – site disposal and treatment of domestic liquid waste.

1.2 Land Capability Assessment

Put simply, land capability is the ability of land to support a particular type of use without causing permanent damage (Austin and Cocks, 1978). Land capability refers to the evaluation of biophysical factors of land for a particular use. In this study the soil and landform characteristics of the outer Perth metropolitan area (Darling Range and Swan Coastal Plain) have been considered in relation to on—site septic tank effluent disposal.

The essence of land capability assessment is a comparison of the physical requirements for a particular land use (on-site effluent disposal) with the qualities of land. Land qualities are attributes of land which influence its capability for that use. Examples of land qualities are soil absorption ability and flood hazard.

The requirements of a particular land use can be expressed in terms of a list of essential and desirable land qualities. The degree to which the natural land conditions meet these requirements determines the land capability class assigned to a particular parcel of land (land unit). In assessing land capability two aspects need to be considered:—

- the effect of land on the proposed use, and
- the effect of that use on the land.

The first aspect relates directly to productivity or development costs while the second relates to conservation requirements.

A five class system is employed by the Department of Agriculture to express land capability (refer Table 1.1). Land rated class I will have qualities which meet the requirements of a proposed land use without any resultant on or off-site land degradation. Land rated from class II to IV becomes progressively less capable of meeting those requirements with the risk of land degradation increasing accordingly. Land rated class V is regarded as prohibitive in terms of the risk of land degradation, or in terms of development costs.

Table 1.1. General land capability class definitions

Capability class	Degree of imitation	General description
I	None to very slight	Very high capability for the proposed activity or use. Very few physical limitations present which are easily overcome. Risk of land degradation is negligible.
II	Slight	High capability. Some physical limitations affecting either productive land use or risk of land degradation. Limitations overcome by careful planning.
III	Moderate	Fair capability. Moderate physical limitations significantly affecting productive land use or risk of land degradation. Careful planning and conservation measures required.
IV	High	Low capability. High degree of physical limitations not easily overcome by standard development techniques and/or resulting in a high risk of land degradation. Extensive conservation requirements.
V	Severe	Very poor capability. Severity of physical limitations is such that its use is usually prohibitive in terms of either development costs or the associated risk of land degradation.

2. Previous Methods of Assessment

The first land capability rating tables for effluent absorption fields appear to have been developed by the Soil Conservation Service of the U.S. Department of Agriculture (Soil Survey Staff 1971) with emphasis on disposal rather than purification of effluent. The basic site parameters outlined by USDA, and by most other rating systems developed since then are permeability, depth to watertable, depth to bedrock and site slope.

The class boundaries for these parameters in the USDA system are probably based on a combination of field observations, common sense and intuition. Class boundaries in other rating table systems developed since then are similar with some adjustments for local circumstances. Within Australia the rating table used by the Land Protection Service (LPS) of the Department of Conservation, Forests and Lands in Victoria (Rowe get al.1981) is perhaps the best known example of a system which has been modified from that of the USDA Soil Conservation Service. The LPS system is shown in Appendix 1.

Brouwer, J. (1979) has conducted a study of land capability assessment for septic tank effluent disposal and considers the LPS modifications made to the original USDA class limits for all parameters are more in line with recent literature and with field observations, at least in Victoria. In particular, changes in class boundaries for permeability reflect the greater effect that evapotranspiration has on effluent disposal in most of Australia. However Brouwer also considers that the rating system used by LPS overestimates the detrimental effects of steep slopes, low soil permeability and shallowness to rock on the functioning of leach drains. He also notes that the Victorian system whilst taking account of subsoil shrink—swell potential, does not consider the potentially limiting effect of dispersible clays.

Brouwers study recommends that land capability rating tables such as that used in Victoria by the LPS, be replaced by an evaluation system wherein disposal field size and type is related to land unit or soil type, vegetation and climate similar to systems used in the U.S. and earlier proposed by Bouma (1975).

3. Factors Affecting Land Capability for Effluent Disposal

Assessment of the ability of land to support an on—site effluent disposal system involves consideration of five land qualities. These are:

- the ability of land to effectively dispose of, or absorb effluent;
- the ability to effectively purify effluent;
- the relative ease of excavation for installation of tanks and leach drains;
- the risk of water pollution; and
- flood hazard.

The soil or land characteristics which need to be considered in relation to each land quality are shown below in Table 3.1 and are discussed in the following pages.

Table 3.1. Land characteristics used to assess qualities which affect effluent disposal capability

Absorption ability	Purification ability	Ease of Excavation	Water pollution risk[1]	Flood hazard
• Site drainage / depth to seasonal watertable.	• Permeability	• Depth to rock • Slope • Stone content	• (by overland flow) • Absorption ability • Runoff	• Landform / topographic prosition[2]
Permeability • Depth to impermeable layer • Stone content	• Nature of soil; texture and coherence • Depth to impermeable layer • Site drainage • Slope	• Rock Outcrop • Site drainage	(by sub-surface leaching) • Nature of soil; texture and coherence	• Field observation of flood events

1. Assessed for units at margins of waterbodies, streams and rivers or where land units overlie superficial groundwater aquifers where nutrient loading or bacterial contamination is of concern.

2. Correlated with W.A.W.A. flood study mapping.

3.1 Depth to Watertable/Site Drainage

Depth to the seasonal watertable (be it a superficial aquifer or perched) is the depth of soil available to receive and purify effluent. In conjunction with properties determining soil permeability, depth to the watertable will directly influence the effluent travel time available for removal of microbes and for organic, and some inorganic materials, to be oxidised or broken down before reaching water.

On-site pollution of domestic water supply for non—serviced rural—residential developments is not a problem since individual households usually obtain their water supply from a roof top catchment. The major concern however with respect to depth to groundwater is the risk of excess nutrient loading and the subsequent eutrophication of open waterbodies. When considering the potential for off-site water pollution (bacterial contamination or nutrient loading) it is important to know whether the seasonal water table represents the superficial aquifer or a locally perched watertable. A perched watertable is a local zone of saturation held above the main body of groundwater by an impermeable layer, usually clay, and separated from it by an unsaturated zone (Houghton and Charman 1986). Whilst groundwater levels associated with a superficial aquifer may vary seasonally, the water is perennial and occurs over zones which are more regional in extent.

- Bacterial contamination

To protect public health the Water Authority of Western Australia will not permit on-site effluent disposal in areas where the immediate groundwater is reserved for domestic consumption. In other areas where septic tanks are allowed, a minimum horizontal distance of 30 m is required between the location of any groundwater bores and a septic tank. This distance is based on a horizontal travel time for bacteria and viruses.

The accepted standard depth of soil required for proper microbe removal from effluent applied to soil is 1.2 m (Wagner and Lanoix 1958). This standard is used by the Western Australian Department of Health irrespective of soil type. Brouwer (1979) considers that except in sands, purification of septic tank effluent is mostly sufficient after less than a metre of unsaturated flow. Parker (1983) however casts some doubt on the suitability of a 1 or 1.2 m standard for coarse sandy soils.

Parker’s field and laboratory data indicate that highly leached coarse sands (Bassendean association*) are ineffective for septic tank effluent purification, whereas sands of the Spearwood association are effective for microbe removal after a depth of 0.65 m of effluent travel. Parker suggests the difference between the soils may be due to minor, but significant, differences in clay content. Little data are available comparing clay contents for the two associations however the greater ability of Spearwood soils to fix nutrients is considered to be due to small amounts of iron oxides which coat the sand grains and this may also affect bacterial purification ability. Minor differences in clay content could also be significant. Marshall (1976) reports that as the clay content of soils increases, bacterial and viral adsorption increases. Specifically, it is the cation exchange capacity of the clay fraction which is responsible for adsorption of microbes. Parker also reports that despite a high calcium content within coastal calcareous sands (Quindalup association) removal of bacteria is quite poor.

* Refer to Bettenay et al. 1960 for descriptions of soil associations of the Swan Coastal Plain.

To determine suitable ‘depth to watertable’ criteria for complete removal of bacterial contaminants from effluent in sandy soils is difficult. Within sands are not highly leached and may have a minor, but significant, clay content (e.g. Spearwood) Parker (1983) considers a depth of not less than 2.0 m of permanently unsaturated soil is adequate. No recommended minimum depth could be given by Parker for highly leached coarse, grey or pale coloured sands (e.g. Bassendean and Quindalup associations). Complete removal of bacterial contaminants within such soils is unlikely and, unless groundwater is to be used as a source of potable water it is probably unnecessary. Such water sources should be protected from bacterial contamination by existing W.A.W.A. regulations.

- Nutrient loading

Where nutrient loading of waterbodies from septic tank effluent is of concern the Environmental Protection Authority recommends 1.5 m minimum depth to groundwater from the base of a leach drain. This recommendation is also made irrespective of soil type. Studies on losses of nutrients applied as fertilizer on coarse rapidly permeable sands (Bassendean association) within the Peel Harvey Catchment by Schofield et al.(1985) suggest that 1.5 m depth may not be sufficient to protect the underlying watertable from nutrient loading.

- Suggested criteria for depth to watertable

A capability rating system for on—site effluent disposal must utilize criteria which are relevant to relatively broad scale mapping units as well as to individual site assessments. The depth to watertable criteria affects purification ability which directly determines the risk of both bacterial contamination and nutrient loading.

Where data are available on depth to watertable the following depth classes may be used.

Table 3.2. Depth to watertable classes

Soil	Purification ability Depth to Watertable			
	< 1 m	1-2 m	2-5 m	> 5 m
Uniform coarse grey or pale leached sands with little coherence (e.g. Bassendean and Quindalup)	Very low	Very low	Very low	Low
Uniform coloured or earthy sands with slight to moderate coherence (e.g. Spearwood)	Low	Moderate	High	High
All other soils with loamy textures or heavier	Low	High	High	High

* Depth measured from soil surface. Note that without hydrological data it may be impossible to distinguish between groundwater level and level of a perched watertable. The 5 m figure is arbitrary.

In many situations the depth to watertable at the wettest time of year may not be known. Depth to the seasonal or perched watertable can however, be inferred from depth and degree of mottling within the soil profile. On flat terrain this will be largely determined by the depth to any impermeable layer. In duplex soils where sandy topsoils overlie a clayey substrate, a perched watertable may exist for several days, weeks or months. It is preferable therefore to define the effect of the seasonal watertable in terms of site drainage status which indicates the length of periods of saturated conditions. Within this study the site drainage classes of McDonald et al (1984) have been used. Whilst these are somewhat qualitative they are defined in terms of approximate lengths of periods of saturation as follows:

Table 3.3. Drainage classes

Drainage Class	Approximate period of saturation
Very poor	Water table remains at or near the surface for most of the year
Poor	All soil horizons remain wet for periods of several months
Imperfect	Some soil horizons are wet for periods of several weeks
Moderately well	Some soil horizons may remain wet for as long as one week after water addition
Well	Some site horizons may remain wet for several days after water addition
Rapid	No soil horizon is normally wet for more than several hours after water addition

These site drainage classes, recorded during all soil or land resource surveys, can be used as an indicator or substitute for 'depth to seasonal watertable' in order to derive a capability rating for a mapped land unit.

3.2 Proximity to Streams or Waterbodies

The U.S.D.A. recommends that as a general rule, effluent disposal areas be sited at least 15 m from any stream or waterbody into which unfiltered and contaminated effluent can escape and spread (cited in Brouwer 1979). Within Western Australia the Environmental Protection Authority have adopted an arbitrary figure of 100 m horizontal distance between on—site effluent disposal areas and waterbodies or streams (Holmes P. pers. comm.). In order to derive capability ratings applicable to mapped land units water pollution risk must be considered for those units which occur exclusively at the margin of waterbodies streams or rivers. The derived ratings then apply to the whole of the land unit for mapping purposes. For individual site assessments the derived rating applies only as far as 100 m from the waterbody.

3.3 Position Relative to Flood Hazard Areas

Flooding of an absorption field inhibits effluent absorption and may physically damage tank units and leach drains. Effluent subsequently rising to the surface may become a public health hazard. Effluent absorption areas should therefore not be sited in areas subject to flooding.

The Water Authority of Western Australia has produced detailed flood study maps for a number of river systems on the coastal plain. These delineate two flood hazard areas. A high hazard rating is associated with active floodways. Areas between this and the 1:100 yr flood level are designated a lower hazard rating. Within designated high hazard areas residential development, and hence on-site effluent disposal, is generally not permitted. In the lower hazard areas, residential development is generally permitted provided houses are located on sand pads which place them above the 1:100 yr flood level. In such areas the sand pads are constructed to accommodate both the house and an on-site effluent disposal system.

In areas of minor drainage systems or where W.A.W.A. flood study maps do not exist, a flood rating is determined from whatever site records or field evidence (e.g. position in landscape) are available. In such situations three hazard ratings are used, high, moderate and low. The high rating applies to units in the immediate proximity to major rivers and streams. Moderate ratings apply to units containing incised drainage lines within the foothills, on the surface of the coastal plain, or within minor upland valleys on the Darling Plateau. Low ratings apply to higher terraces of major rivers, which are areas expected to generally fall within the 1:100 yr flood limit, and also to non-incised ill defined drainage pathways associated with minor creeks and streams.

3.4 Permeability

Permeability is the characteristic of soil which governs the rate at which water moves through it. It is a composite expression of soil properties and depends largely on soil texture, soil structure, the presence of pans and the size and distribution of pores in the soil. Permeability categories are essentially ranges of hydraulic conductivities.

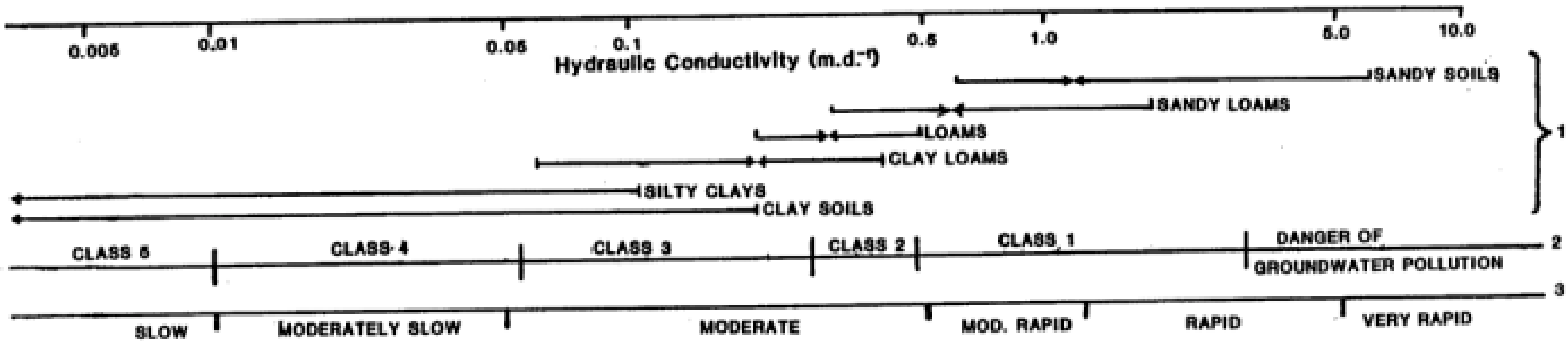
Qualitative categories of permeability and approximate limits for each category in terms of saturated hydraulic conductivity* are listed below and also in Figure 2 overleaf.

Table 3.4. Permeability classes

Permeability	Saturated hydraulic conductivity
Slow	< 0.01 m per day
Moderately slow	0.01-0.05 m per day
Moderate	0.05-.5 m per day
Moderately rapid	0.5-1 m per day
Rapid	1-5 m per day
Very rapid	> 5 m per day

* Because it is a simpler test to conduct, percolation rate rather than saturated hydraulic conductivity, is the parameter most frequently measured by local government health authorities during site assessment. Unfortunately this parameter bears little relationship to saturated hydraulic conductivity, which, where possible, should be measured using the method of Talsma and Hallam (1980).

FIG. 2 Comparison of proposed permeability rating classes with L.P.S. capability classes and conductivities for various soils.



1. Representitive conductivity and normal range for various soils (ISRAELEN and HANSEN 1962).

2. Capability rating . Soil Conservation Authority*,Victoria (ROWE et al 1981).

3. Proposed permeability classes ,Western Australian Department of Agriculture.

* Now Land Protection Service ,Department of Conservation ,Forests and Lands,Victoria.

The upper limit for the slow category and the lower limit for rapid are comparable with those in general use (McDonald et al. 1984, Houghton and Charman 1986). The moderate category from McDonald et al. (1984) has however been split into three to increase descriptive freedom.

In figure 2 comparison of the permeability categories with those of the LPS capability rating system is shown against data on representative conductivities for various soils from Israelsen and Hansen (1962). In comparison with the LPS system, the slow category is much lower which may alleviate the concern by Brouwer (1979) about possible overestimation of the detrimental effects of low permeability. The very rapid category is introduced to highlight the problem of inadequate purification of effluent in soils where percolation is excessive. Very rapid percolation is accompanied by increased danger of water pollution.

3.5 Slope

High slopes may make construction of soil absorption systems difficult. Due to colluviation there is often more chance of encountering shallow bedrock on high slopes than lower ones. Hence ineffectively purified effluent may come to the surface as it flows downslope.

Brouwer (1979) considers both the USDA slope requirement (< 10%) and the Victorian LPS slope class limits too restricting. It is unclear however whether. this applies to the ability of land to purify effluent without surface seepage, or to the relative ease of excavation. Due to interaction of slope with other characteristics such as soil texture and depth there is room for argument about when high slopes begin to hinder construction and when lateral flow of effluent and subsequent seepage spots will become a problem. In view of this, different slope classes have been used during the assessment of ‘purification ability’ compared to that for ‘ease of excavation’ (refer Tables 4.3, 4.6).

3.6 Stone Content

High contents of stone within the soil profile can affect the ease of excavation for an absorption fields and can affect the flow of effluent. Stone abundance classes, similar to those employed in the LPS rating system, but adjusted to correspond with those defined by McDonald et al. (1984), are used here and shown below.

Table 3.5. Stone classes

Abundance within soil profile	
Nil to common	< 20%
Many	20-50%
Abundant	50-90%
Very abundant	> 90%

3.7 Dispersible Clays

Dispersible clays are likely to inhibit downward percolation of effluent due to their poor structural condition. However such a condition is also likely to be reflected by relatively impermeable subsoil and poor drainage status and these factors will already have been taken into account under the 'depth to seasonal watertable' factor.

3.8 Depth to Rock

Leach drains are normally installed 20—60 cm beneath the soil surface. Rock formations should be of sufficient depth below the bottom of leach drains or soak wells to provide adequate filtration and purification of septic tank effluent. The U.S. Soil Conservation Service and the Victorian L.P.S. recommend at least 1—2 m below leach drains however, Brouwer (1979) considers this figure overestimates the detrimental effect of depth to rock in Victoria.

A clear distinction needs to be made between the effect of depth to rock on 'ease of excavation', and that on effluent 'absorption ability' and effluent 'purification ability'. Sufficient aeration and soil depth are required for effective removal of microbes and for the oxidation and breakdown of various organic and inorganic materials within the effluent.

With respect to effective absorption and purification, the important characteristic is 'depth to an impermeable layer' rather than 'depth to rock'. An impermeable layer may be bedrock, but in many cases where soils are not strongly structured, the impermeable layer may be the clay subsoil. An effective impermeable layer may also be the seasonal watertable. The specific characteristic 'depth to rock' is therefore used only in relation to assessing relative ease of excavation for shallow leach drains. Elsewhere the term 'depth to an impermeable layer' is used.

If the U.S. or Victorian depth standards are used in areas of the Swan Coastal Plain or Darling Range, the detrimental effect of 'depth to rock' may again be overestimated. This is due to either relatively permeable bedrock conditions or the high variability of 'true' soil depth in many rocky areas. For example within the dunes of the Spearwood association the underlying aeolianite (Tamala limestone) is moderately permeable and solution cavities filled with unconsolidated sand occur irregularly (Biggs 1977). In addition, where the limestone occurs in pinnacle rather than sheet form, actual soil depth is highly variable even within areas of considerable surface rock.

In areas of the Darling Scarp and foothills actual soil depth may also vary due to rock 'floaters' within the soil profile in colluvial areas. On the face of the Scarp, topographic highs occur in depth to basement rock where doleritic dykes intrude through the granitic and gneissic country rock. Where gravelly soils mantle lateritic duricrust, the detrimental effects of shallow soils on effluent disposal may be lessened due to the presence of preferred pathways which assist downward percolation (Johnston et al.1983).

In view of the nature and variable depth of bedrock within the Darling Range and Swan Coastal Plain, and considering comments by Brouwer (1979) on the U.S. and

Victorian depth criteria, different depth values have been used within the rating tables for each of the land qualities (ease of excavation, absorption ability, and purification ability). Note that in most areas of the Swan Coastal Plain and Darling Range where rock is likely to influence on-site effluent disposal ‘depth to rock’ will usually approximate ‘depth to an impermeable layer’. Standard depth classes are as follows:

Table 3.6 Depth classes

Very shallow	< .25 m
Shallow	0.25 – 0.5 m
Moderately deep	0.5 – 1.0 m
Deep	> 1 m

Within the rating table for soil purification ability extra depth classes occur within the ‘deep’ category for rapidly permeable sands (i.e. 1-2 m, > 2 m, > 5 m).

4. Proposed Method of Assessment

The proposed assessment system has been developed from that of the Victorian LPS with modifications made to ratings for certain parameters as suggested by Brouwer (1979), and, also to account for local observations. The system is based on the assessment of a number of land qualities, each of which is determined from data on soil or land characteristics for land mapping units, The land qualities considered are:

- soil absorption ability;
- soil purification ability;
- ease of excavation for tank or trench installation;
- water pollution risk - by overland or surface flow
- by subsurface leaching; and
- flood hazard.

4.1 Land Capability Rating Table

An assessment rating of the capability of a mapped land unit to support on-site effluent disposal is determined using Table 4.1. For each land unit values for land qualities to fit into the capability rating table are determined from quality assessment tables (Tables 4.2 and 4.6). Soil or land characteristics listed in the quality assessment tables are described or quantified in Section 3 of this report. Specific data for each mapped land unit are obtained from soil or land resource surveys.

Table 4.1.

Land Capability Rating[1] Table for on-site effluent disposal -areas capable of being used for soil absorption and purification of septic tank effluent from a single family dwelling.

Land qualities[2]		**Capability class**				
		I	II	III	IV	V
		(Nil ……………..Degree of limitation			……..…………..Severe)	
Soil purification ability	p	High	Moderate	Low	Very Low	-
Water pollution risk[3]						
- by overland flow	o	Very low	Low	Moderate	High	Very high
- by subsurface leaching	s	-	-	Low	High	Very high
Ease of excavation	x	High	Moderate	Low	Very Low	-
Soil absorption ability	a	High	Moderate	Low	Very Low	-
Flood hazard	f	-	-	Low	Moderate	High

Notes

1. Capability class determined by most limiting factor.

2. Values for each land quality assessed in separate Tables (4.2-4.6) which relate data on relevant land characteristics.

3. Pollution risk generally only applicable to map units at margins of a waterbody or overlying superficial aquifers which feed into environmentally sensitive waterbodies.

4.2 Assessment of Land Qualities

Absorption ability — This relates to the ability of soil to accept sufficient volumes and rates of applied effluent. It is determined from a consideration of soil permeability, site drainage, depth to an impermeable layer and the presence of stones within the soil profile.

Table 4.2. Assessment of land quality — Absorption ability[1]

Land characteristics	Rating			
	High	**Moderate**	**Low**	**Very Low**
Permeability class.	Very rapid – rapid	Moderate – Moderately – rapid	Moderately slow	Slow
Drainage class [2]	Well – Rapid	Moderately well – Imperfect	Poor	Very Poor
Depth impermeable layer	Deep	Moderately deep	Shallow	Very shallow
Stone within profile	Nil – Common	Many	Abundant	Very abundant

1. The rating will be determined by that of the most limiting land characteristic

2. For many soil surveys drainage class will need to be used in lieu of 'depth to seasonal watertable'. If however, sufficient depth data are available, Department of Health criteria should be used for site specific assessment. i.e. 1.2 m below base of effluent leach drains, or 1.8 m below soil surface is sufficient, and for the purpose of determining a capability rating, absorption ability is automatically high.

3. Note that if the absorption ability is low or very low there will be a high risk of on—site pollution.

- Purification ability - This relates to the ability of soil to effectively remove microbes which may be detrimental to public health, and to provide suitable conditions for oxidation or breakdown of organic and some inorganic materials within effluent.

Table 4.3. Assessment of land quality — Soil purification ability

Permeability	Nature of soil	Depth to impermeable layer*	Rating
Moderately rapid – Very rapid	Grey or very pale leached sands with little coherence	< 5 m >5m	Very low Low
	Coloured sands (usually yellowing brown to red and earthy sands with slight to moderate coherence	> 2 m 1 – 2 m < 1 m	High Moderate Low
Moderate – Slow	Soils with loamy textures or heavier.	> 1 m 0.5 – 1 m < 0.5 m	High Moderate Low

• Depth to rock, impermeable poorly structured clay, or seasonal watertable if known.

Rating modifiers

1. If site drainage is very poor soils will be insufficiently aerated for bacterial breakdown of effluent components. Rating is automatically very low.

2. On steep slopes where permeability is moderate-slow, lateral seepage may intercept the surface resulting in ineffective purification. Therefore under such permeability conditions, if slope is 20—30% rating is automatically low, and if > 30% rating is very low.

• Water pollution risk

The risk of water pollution from on-site effluent disposal relates to excess microbial and/or nutrient contamination and is usually an off—site problem. Pollution risk is considered for map units at margins of a waterbody or those which overlie superficial groundwater aquifers where nutrient loading or bacterial contamination is of concern.

- by surface or overland flow

Water pollution risk from surface or overland flow is determined from soil absorption ability and surface runoff rates with a modifying factor for flood hazard areas.

Table 4.4.

Assessment of land quality - Water pollution risk from surface runoff or overland flow.

Absorption ability*	Runoff rate	Risk rating
High	-	Very low
Moderate	Nil-Slow	Low
	Moderately rapid – Very rapid	Moderate
Low or Very low	Nil-Slow	Moderate
	Moderately rapid – Very rapid	High

* Determined from Table 4.2.

Rating Modifier

If site subject to high flood hazard, risk rating is automatically very high. For low flood hazard, risk rating is automatically high.

- by subsurface leaching

Water pollution risk by subsurface leaching is determined from a 'nutrient retention' rating which in turn is based on subsoil texture and coherence. The risk of bacterial contamination by subsurface leaching is relevant only for soils with a low or very low purification ability. In these soils nutrient retention ability will be of equivalent severity or more limiting. Therefore to determine a water pollution risk by subsurface leaching, only the nutrient retention rating need be used.

Table 4.5.

Assessment of land quality - Water pollution risk by subsurface leaching.

Subsoil texture group	Nature of soil	Nutrient retention rating	Pollution risk rating
Sands	Grey or very pale leached sands with little coherence	Very low	Very high
	Coloured sands (usually yellowish brown to red) and earthy sands with slight to moderate coherence	Low	High
Sandy loam or Loams	-	Moderate	Low
Clay loam or Clays	-	High	Low

• Ease of excavation - this relates to the relative ease of installation for septic tank units and for construction of leach drains or soak wells.

Table 4.6. Assessment of land quality - Ease of trench excavation ratings*

Land Characteristic	High	Rating Moderate	Low
Depth to rock	Deep	Moderately deep	Shallow
Slope	0-10%	10-20%	>20%
Stone within profile	Nil – Common	Many – Abundant	Very abundant
Rock outcrop	Nil – Very few	Few	Common or more
Site drainage[1]	Rapid – Moderately well	Imperfect – Poor	Very poor

* Rating determined by that of the most limiting land characteristic

1 Affects need to shore up sides of excavation against collapse

- Flood hazard - Flooding is the temporary covering of land by water from overflowing streams, and to a lesser degree, from excessive runoff from adjacent slopes. Hazard ratings are determined from published W.A.W.A. flood study maps where available. In other areas ratings are largely based on inference from landform and soils data. General definitions of the ratings are as follows:

Table 4.7. Assessment of land quality — Flood hazard

Flood hazard	Description
High	• lowest terraces and margins of major rivers and streams; • active floodways as defined by W.A.W.A. maps
Moderate	• intermediate level terraces of major rivers and streams, incised drainage lines, and minor valley floors
Low	• higher terraces of major rivers and streams non-incised ill defined drainage pathways associated with minor creeks and streams; • land occurring outside active floodway areas but within the 1:100 year flood level as defined by W.A.W.A. maps

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Appendix 1

VICTORIAN LAND PROTECTION SERVICE

LAND CAPABILITY RATING FOR ON-SITE EFFLUENT DISPOSAL areas capable of being used for on-site soil absorption of all-waste septic tank effluent from a single family dwelling

Land features affecting use	**Capability Class**				
	1	**2**	**3**	**4**	**5**
Slope	0% to 5%	5% to 8%	8% to 15%	15% to 30%	More than 30%
Site drainage	Excessively well drained, Well drained	Moderately well drained	Imperfectly drained	Poorly drained	Very poorly drained
Flooding return period	None	None	None	Less than 1 in 25 years	More than 1 in 25 years
Depth to seasonal watertable	More than 150 cm	150 cm to 120 cm	120 cm to 90 cm	90 cm to 60 cm	Less than 60 cm
Permeability K value	Rapid More than 1.0 m/day	Moderately rapid 1.0 - 0.3 m/day	Moderately slow 0.3 - 0.1 m/day	Slow 0.1 - 0.05 m/day	Very slow Less than 0.05 m/day
Depth to rock or impervious layer	More than 200 cm	200 cm to 150 cm	150 cm to 100 cm	100 cm to 75 cm	Less than 75 cm
Gravel and stones	Less than 5%	5% to 20%	20% to 40%	40% to 75%	More than 75%
Boulders, rock outcrop	Less than 0.02%	0.02% to 0.2%	0.2% to 2% -	2% to 10%	More than 10%
Shrink-swell potential	Less than 4%	4% to 12%	12% to 20%	More than 20%	-

Permeability: Where possible this is based on determination of hydraulic conductivity “K”. Where K exceeds 6.0 m day, risk of polluting water bodies must be considered.

Depth to watertable: These depths correspond to site drainage assessment terms as used in the site drainage classes.