Rural Servicing Assessment for Upper Hutt

PREPARED FOR UPPER HUTT CITY COUNCIL

August 2020

NZET Ltd

UPPER HUTT RURAL SERVICING ASSESSMENT

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Quality assurance statement

Task	Responsibility	Signature
Project manager:	Stu Clark	
Prepared by:	Mark Trainor	
Reviewed by:	Stu Clark	
Approved for issue by:	Stu Clark	

Prepared by:

NZET Ltd
81 Gillespies Road Upper Hutt.
PO Box 40-339 Upper Hutt
Phone: 04 526 4109 Fax: 04 526 4190
Email: office@nzet.net.nz

Stu Clark CP Eng. #58384 civil, structural, environmental

Mark Trainor BSc, PGDip – Engineering Geologist

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Contents

1. Introduction

Upper Hutt City Council (UHCC) is undertaking a review of its rural and residential District Plan provisions, including zoning extents. The project will culminate in what is called 'Plan Change 50 (PC50)' to the Upper Hutt District Plan, with draft proposals anticipated to be released for public consultation in mid-2021.

Since the beginning of 2019 UHCC has been completing large scale reporting to support the review. In March 2020 Council publicly released this reporting and their assessment of potential issues and opportunities for rural and residential areas. Feedback on these is currently being reviewed in preparation for the next phase of public engagement, due in the latter part of 2020.

This report has been prepared as an assessment on rural servicing requirements in the Upper Hutt district to determine the area required within rural allotments for the purposes of servicing dwellings, where no public three waters servicing is available/provided.

This evaluation covers the area needed over a variety of rural landforms to provide for:

a. Septic tank(s) or wastewater treatment plants;
b. Wastewater discharge field(s);
c. Rainwater collection tank(s); and
d. Stormwater soak pit(s)/discharge

for a period of occupation of 50 years including additional land that may be required over that time to provide adequate servicing.

2. Scope of Work and Methodology

NZET Ltd have been engaged by UHCC to undertake additional reporting on rural servicing areas to assist with determining the reasonable minimum rural allotment sizes required in rural areas of Upper Hutt, given the mentioned servicing requirements. This assessment also evaluates any variables that may further alter or influence area requirements, while also factoring in likely separation distances between servicing areas (e.g., between discharge fields and stormwater soakage pits, or between discharge fields and dwellings, etc.) along with the suitability of servicing for the different rural landforms.

Sites created by subdivision need to be of a sufficient size to enable servicing requirements to be met. Subdivision and provision of services which mitigate the effects of development on the environment are closely linked. It is important that sites are of a sufficient size to make it possible for them to be adequately serviced.

In this assessment, minimum area requirements for onsite servicing are determined based on a matrix type analysis. The matrix analysis factors the development requirements of rural land parcels based upon environmental and site-specific constraints. The basis uses criteria or factors, which assess the development potential of rural properties based on resources unique to the particular site.

3. Limitations

The information contained in this document has been gathered specifically for the UHCC for the purposes listed above. No specific liability is accepted for any of the information presented, as the information is an indication of what is considered to be the general current level of serviceability of the land. Land at a section-scale could, in fact, be classified differently from the assessment in this report. Properties that straddle two land types should be initially assessed based on the higher risk category.

It should be noted that the land type serviceability potentials are based on soil and rock types, and broadly categorised slope gradients and therefore represent the general picture at a regional scale. Soils at a section-scale could be classified differently from the larger scale assessment.

Other factors are also involved in dictating whether or not a given site is suitable for onsite wastewater disposal. For example, site specific landforms are also critical, especially since discharging wastewater, or stormwater, to the ground can induce movement in otherwise stable ground. Even if a land type is assessed as having good disposal potential, individual sites within that land type may still be unsuitable to accept wastewater and stormwater to ground. The land type assessments are produced to help Council with planning at the scale indicated and should not be used to replace site specific assessments, which should be carried out prior to any specific site development.

This report summarises the process that have been used for determining onsite servicing area requirements and therefore sustainable rural lot sizes. Though discussed, this report does not necessarily fully account for the cumulative effects of numerous systems operating within an area and their potential to cause degradation of the downstream environment.

4. Matrix Assessment Criteria

The criteria used in the matrix assessment includes; landform types, onsite wastewater discharge options, stormwater discharge options and rainwater collection requirements. The assessment criteria are based on a general rural residential population of a three-bedroom dwelling and an additional one-bedroom self-contained family flat, which is a permitted activity under the current Upper Hutt Operative Plan rural zone provisions and represents a relatively common scale of occupancy.

The main factors in determining minimum Lot sizes will be the rural land type category, as per Section 6 below, onsite wastewater disposal requirements, due to the land area required for discharge, and population per Lot requirements (6 people per Lot used in this assessment).

Further determining factors relating to stormwater discharge, rainwater collection/storage requirements and rural firefighting water supply requirements have also been adopted into the matrix criteria to help determine water tank and detention volume needs.

5. Upper Hutt Rural Areas

Rural areas of Upper Hutt most likely to be subject to rural residential development include the following areas:

- Te Marua
- Mangaroa Valley
- Whitemans Valley
- Gillespies
- Akatarawa Valley
- Kaitoke
- Moonshine Valley/Settlement

These areas have been outlined in the recent Rural Land Use Assessment report (RLUA) by Perception Planning[1] as being considered by the Council to be the most likely rural areas to be subject to development pressure for rural residential development.

The greater extent of rural localities in Upper Hutt is shown in Figure 1.

[1] Perception Planning 2019 Rural Land Use Assessment report (RLUA)

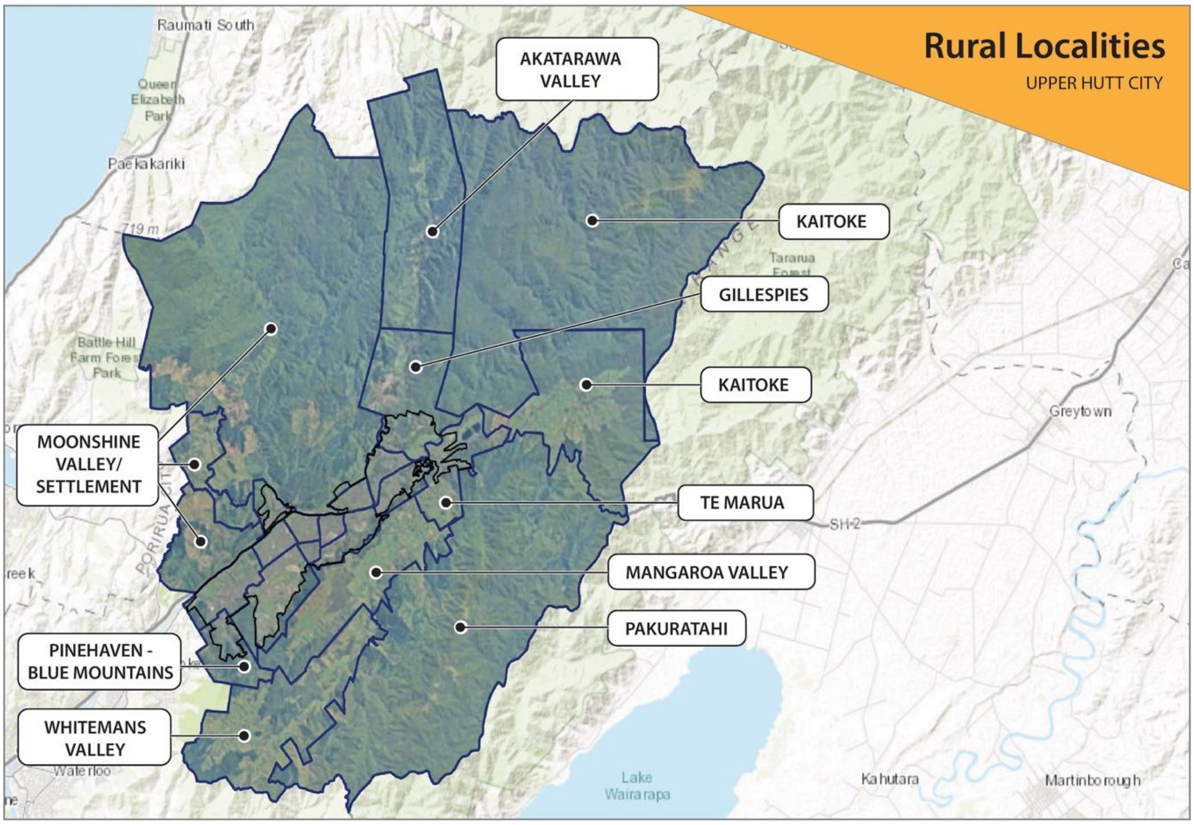

Figure 1: Rural Localities Map

6. Rural Land Type Categories

Rural land type categories have been adopted for general classification of rural Upper Hutt topographies. The landforms and geologies listed in Table 1 below will influence the design requirements of septic tank(s) or treatment systems, wastewater discharge fields and stormwater soak pits and aid in the selection of minimum Lot size requirements for future rural residential development.

Table 1: Rural land types

Rural Land Type #	Rural Landform	Assumed geology
1	Flat to low gradient	Alluvial Gravels / Gravel deposits (Q1a)
2	Flat to low gradient	Alluvium (Q1-Q4)
3	Flat to low gradient	Peat / Swamp
4	Moderate slope (<26°)	Alluvium (Q5-Q11)
5	Slopes (>26°) and Hilltops	Sandy silt (1-5m) over bedrock / Overburden soils (2-4m deep) over bedrock

6.1 Land Type Geologies

The list below summarises the assumed land type geologies mentioned in Table 1. Descriptions are based off local geomorphic and topographic knowledge of the Upper Hutt area, a review of existing geological publications for the area, the NZET database that has developed as a result of the wide range of site investigations that the firm has carried out in the Upper Hutt area, existing bore log data obtained from the New Zealand Geotechnical Database, the 1:250 000 geological map 10 of the wellington Region[2] and the PC50 Upper Hutt Geotechnical Assessment undertaken by Coffey Services (NZ) Limited[3].

6.1.1 Land Type 1 - Gravels / Gravel deposits (Q1a)

Alluvial gravels are generally found in relatively flat river terrace areas and occur in only small localised areas within the rural landscape. They consist of generally well sorted floodplain gravels with minor sand and silt. Alluvial gravels of this type are considered to have high permeability rates.

6.1.2 Land Type 2 - Alluvium (Q1-Q4)

These flat to low gradient alluvium deposits are usually present in lower valley areas. They generally consist of poorly to moderately sorted gravel with loess, swamp sediments and minor pedogenically altered tephra deposits. They are considered to generally have moderate permeability.

6.1.3 Land Type 3 - Peat / Swamp

Peat and swamp deposits are found in low lying valley floors and are made up of poorly consolidated silt, mud, sand and peat. Swamp deposits generally have a high water table due to their low-lying topography, this coupled with fine sediment particle sizes, provide very low permeability rates and limited soil moisture storage.

6.1.4 Land Type 4 - Alluvium (Q5-Q11)

These alluvial deposits are predominantly found on low to moderately sloping (<26^{o}) land and can be described as fan deposits consisting of weathered, poorly to moderately sorted gravels with sand and silt. They can often underly a reasonably thick soil layer (>5m thick) with variable permeability rates dependant on soil particle size.

6.1.5 Land Type 5 - Sandy silt (1-5m) over bedrock / Overburden soils (2-4m) over bedrock.

These soil types are found on steeper valley slopes >26^{o} and have a thinner soil layer than other rural land types due to erosion and weathering factors. The soils are predominantly residual soil weathered from the parent bedrock, typically Greywacke, and are often fine grained and susceptible to slips if saturated. They are generally found to have a low – moderate permeability but are often thin with a shallow limiting bedrock horizon.

7. Onsite Wastewater Serviceability

Minimum lot sizes are an important aspect of onsite wastewater design. The disposal of effluent in New Zealand is generally recommended to follow the Australian and New Zealand Standard for On-site domestic-wastewater management (AS/NZS 1547:2012), the purpose of which is "to provide the

[2] Begg, J. G. (2000). *Geology of the Wellington Area, Institute of Geological and Nuclear Sciences 1:250 000 geological map 10.* Lower Hutt, New Zealand: Geological and Nuclear Sciences.

[3] Martin, S. 2020, PC50 Upper Hutt Geotechnical Assessment. Coffey Services (NZ) Limited

requirements for treatment units and their land application systems to achieve sustainable and effective onsite domestic wastewater management, to protect public health and the environment".

The standard describes different methods of managing wastewater, and the parameters which determine which types of on-site land-application system provides the best practical option for a particular site.

The significant factors in determining the suitability of a site for effluent disposal are; the nature of the soil, thickness of the soil profile, surface water, groundwater levels, and site-specific landforms.

Section 8 and 9 of this report provide an overview of best practice onsite wastewater treatment and disposal systems suitable for Upper Hutt rural landscape characteristics and prescribes the best options for each land type as described in Section 6.

The disposal systems covered in detail are:

a) Pressure compensating dripper irrigation PCDI;
b) Low-pressure irrigation systems (LPED and LPP);
c) Trenches;
d) Beds and;
e) Mounds.

Wastewater disposal area requirements have been based on a 3 bedroom dwelling and a 1 bedroom self-contained family flat on each Lot, with standard water fixtures and onsite rainwater collection using a design flow of 180L/person/day as per AS/NZS 1547:2012. Pre-disposal treatment options will be specific to the required disposal system suited to the site.

The Proposed Natural Resources Plan - Decisions Version for the Wellington Region states the following under *Rule R75: New or modified on-site domestic wastewater systems:*

The discharge of domestic wastewater onto or into land where a contaminant may enter water, and the associated discharge of odour to air from an on-site domestic wastewater treatment and discharge system installed or modified after 31 July 2015 is a permitted activity provided the following conditions are met:

2.1 the discharge shall occur within the boundary of the property, and

2.2 the on-site domestic wastewater treatment and discharge system design shall meet the requirements of AS/NZS 1547:2012 – On-site Domestic Wastewater Management, and

2.3 the flow allowance used to calculate the system design flow must be no less than 145L per person per day where the water supply is provided by roof water collection, or no less than 180L per person per day for other sources of water supply, and

2.4 the discharge shall consist only of contaminants normally associated with domestic sewage, and

2.5 the discharge is not located within:

(i) 20m of a surface water body, coastal marine area or bore used for water abstraction for potable supply, or 50m from a bore used for water abstraction for potable supply when the discharge is from an on-site domestic wastewater treatment and discharge system installed after 31 July 2019, or

(ii) 20m of the boundary of the property unless the land application discharge system consists of a pressure compensating drip irrigation system where the boundary set-back is 5m, or

(iii) 0.1m of the soil surface unless it is covered permanently with a minimum of 0.1m of mulch or similar cover material, or

(iv) a community drinking water supply protection area as shown on Map 26, Map 27a, Map 27b or Map 27c or

(v) a property where there is a wastewater network available, and

2.6 the on-site domestic wastewater treatment and discharge system is operated and maintained in accordance with the system design specification for maintenance or, if there is no design specification, Section 6.3 and Appendices T and U of AS/NSZ 1547:2012 – On-Site Domestic Wastewater Management, and

2.7 the discharge shall not exceed 14,000L/week and a maximum daily volume of 2,000L, and

2.8 the wastewater is discharged evenly to the entire filtration surface of the discharge field and shall not cause ponding or surface runoff from the discharge area, and

2.9 the system is performing effectively, including the sludge and scum layers not occupying more than one half of the system primary tank volume, and

2.10 the following reserve areas shall be provided:

(i) for primary treatment systems using a discharge field basal loading rate, the reserve area allocation must be not less than 100% of the discharge field, or

(ii) for pressure compensating drip irrigation systems, no reserve area is required, or

(iii) for all other systems, the reserve area must be not less than 50% of the discharge field, and

2.11 the discharge of odour is not offensive or objectionable beyond the boundary of the property.

8. Treatment System Effluent Quality

The stages within a treatment unit can be engineered to achieve a range of treatment levels. To accommodate new technologies being developed in the industry, the categorisation of treatment stages is associated with effluent quality only. The estimated treatment quality for these stages (listed from left to right in increasing order of treatment) is presented in Table 2.

Treatment systems assessed in this report have been evaluated through the on-site effluent treatment national testing programme (OSET)[4] by the Water New Zealand Small Wastewater and Natural Systems Special Interest Group. For reference, the OSET grading system is also provided in the table in brackets.

[4] On-site effluent treatment national testing programme operated by the Water New Zealand Small Wastewater and Natural Systems Special Interest Group (SWANS-SIG)

Table 2: Typical wastewater treatment unit stages and associated effluent quality.

Treatment unit stage	Primary treatment	Secondary treatment	Advanced secondary treatment	Advanced secondary treatment with nutrient reduction [Note 2]	Advanced secondary treatment with disinfection [Note 3]
BOD_5 (g/m³) [Note1]	100-140 (D)	≤20 (B)	≤10 (A)	≤10 (A)	≤10 (A)
TSS (g/m³) [Note1]	30-70 (D)	≤30 (C)	≤10 (A)	≤10 (A)	≤10 (A)
Ammonia (g/m³)	<30 (D)	<5 (A)	<5 (A)	<5 (A)	<5 (A)
Total nitrogen (g/m³)	<100 (D)	<40 (D)	<40 (D)	<25 (B)	<40 (D)
Total phosphorus (g/m³)	<20 (D)	<10 (D)	<10 (D)	<8 (D)	<10 (D)
E. coli (CFU/100 mL) [Note 4]	10^6 - 10^{10}	$<10^4$	$<10^4$	$<10^4$	≤200

Notes:

1) 90th percentiles of the samples taken over three testing periods.

2) Enhanced and targeted nitrogen reduction is achieved by recycling nitrified wastewater through an anoxic zone and requires specific design and well-controlled operation.

3) Disinfection can be achieved by either UV or chlorination. The effectiveness of a disinfection system is affected by the wastewater characteristics. High quality of secondary treated effluent is required to ensure effective disinfection.

4) The alternative unit is MPN/100mL. OSET grades for E.coli are not currently used, just the E.coli count.

8.1 Primary Treatment Units

Primary treatment of effluent is most commonly provided by septic tanks prior to discharge into the ground via a land application system. Septic tanks can also be used to provide primary treatment prior to a secondary treatment stage. A septic tank collects greywater (kitchen, bathroom and laundry) and blackwater (toilet waste) and provides a simple retention unit for settling of solids and floatation of oils, grease and fat (scum). The tank operates as a passive, low rate digester, with wastewater passing through as plug flow. A stratification process separates solids depending on the density of the particles relative to water. Separation and biodegradation are natural processes that do not depend on additives. Stratification allows a relatively clear zone, free of solids, to develop in the middle of the tank before being discharged.

Septic tank capacity is based on providing a minimum settling volume equivalent to a total daily flow allowance of 200L/person plus sludge and scum storage at 80L/person/year (accumulated over seven years). This provides a minimum settling time of 24 hours when the sludge/scum volume reaches storage capacity, at which time, the tank will require pump-out.

A minimum septic tank capacity of 3,500L would be required to service a 4 bedroom dwelling. To provide adequate room for a septic tank, conservatively, approximately 10m² should be allocated.

8.2 Secondary Treatment Units

Secondary treatment refers to the typically aerobic biological process in which microorganisms absorb suspended and dissolved organic matter while growing under aerobic conditions, the resulting biological sludge solids being removed by settlement and/or filtering processes.

The main types of secondary treatment units are suspended growth and fixed film activated sludge systems (AS-AWTS), packed bed or textile media reactors, and membrane reactors.

All secondary units require inspection on a regular basis by an experienced operator. Operation and maintenance contracts for the life of the on-site wastewater system are vital. Six-monthly inspections are typical, and except for the most stable influent flow and type of plant, six months is recommended as the minimum necessary to achieve consistent performance. Such operation and maintenance servicing contract arrangements must be maintained for the life of the on-site wastewater system. Servicing will include, for example, checks on the dissolved oxygen level in the effluent as well as periodic analysis of BOD5 and TSS levels. Removal of scum/sludge via pump-out of the septic tank/primary treatment compartment will also be required in most systems at intervals based on operating observations and experience.

An average secondary treatment unit of 1 tank with a volume of 1800L will require approximately on average 10m^2 of land area.

8.3 Hybrid Systems

In addition to the conventional primary and secondary wastewater systems there are a number of hybrid or non-conventional systems which are currently marketed in the Upper Hutt/Wellington area. Some of these systems use separate black and grey water plumbing and treatment, followed by discharge through LPED trenches or a septic tank discharging to an enhanced disposal field comprised of specialised pipe installed in a sand bed.

These systems can provide results which are intermediate in effluent quality between primary and secondary, or in some cases can be enhanced to full secondary treatment quality.

9. Land Application Systems

The land application area receives wastewater from the wastewater treatment unit and provides further treatment and discharge of effluent, via:

- Assimilation through the soil matrix for eventual plant uptake of soil moisture via transpiration
- Evaporation
- Percolation through the soil matrix for eventual assimilation with groundwater

This section provides design specifications and guidance on the selection and design of land application systems, and discusses:

- The options for land application systems (including shallow irrigation and conventional systems) and;
- Sizing and placing the land application area

With shallow soakage or irrigation systems, organic matter in the effluent is taken up by aerobic micro-organisms and vegetation within the well-aerated upper soil layers. This occurs at a faster rate than in anaerobic conditions which predominate in deeper, saturated soil.

It is good practice that wastewater discharges to land application areas (including proposed reserve areas) are not located within:

- Any geotechnical hazard areas (soil warning, unstable ground etc.);
- Any areas earthworked, stockpiled, or compacted by heavy machinery unless specifically designed for effluent disposal;
- Within proximity of any contaminated land and;

- Within the 5% AEP (one-in-20 year) or greater frequency flood plain.

Shallow land application systems can be vented to help maintain long-term acceptance rate values and are essential in all subsurface distribution systems unless aerobic conditions are maintained in the lines (as in PCDI and shallow LPED systems) where effluent is pumped.

Conventional land application systems include; trenches, beds and mounds and were historically the systems of choice before more advanced evapotranspiration and enhanced treatment systems were developed. Conventional soakage systems may be used in well-drained areas with low groundwater tables, although some typical site issues (such as high groundwater level, periodical flooding/inundation, inadequate permeable soil depth or shallow distance to bedrock, etc.) may restrict their use.

The prolonged wet, cold winter of the Upper Hutt climate, compared to more northerly regions of New Zealand, does not favour evapotranspiration dominated systems.

Design details for the most commonly designed shallow irrigation and conventional land application systems are provided below.

9.1.1 Shallow Irrigation Systems

Shallow irrigation systems are well suited to moderate draining soils. In slow draining and fast draining soils, an adequate overlying topsoil depth is needed, and environmental requirements for receiving water impacts must be met.

Areal loading rates are applied to shallow sub-surface or surface irrigation systems. Areal loading refers to the entire enclosing area of the wastewater land application system. The areal design area calculation method is used to size an irrigation area (A) useing a conservative design irrigation rate of 3.5mm/d (DIR) and a wastewater loading rate of 180L/person/day (Q) for 4bedrooms/6 people:

$A = Q/DIR$

Where:

A- The area of irrigation land where the driplines or LPED lines are to be installed (m^2)

Q- The wastewater loading rate (L/d)

DIR- The design irrigation rate (mm/d).

Commonly designed shallow irrigation systems are summarised below.

Pressure compensating dripper irrigation PCDI

Pressure compensating dripper irrigation is the most appropriate land application option wherever wastewater is treated to a secondary standard. Treated secondary effluent typically enters a load-dosing system which typically consists of a dosing tank and a dosing pump with adequate reserve capacity and control mechanisms.

Determining the required land application area for PDCI systems as mentioned above, A = Q/DIR, equates to ~ 300m^2 and with a 5m buffer zone surrounding the application area, 400m^2 should typically be allocated for this type of system.

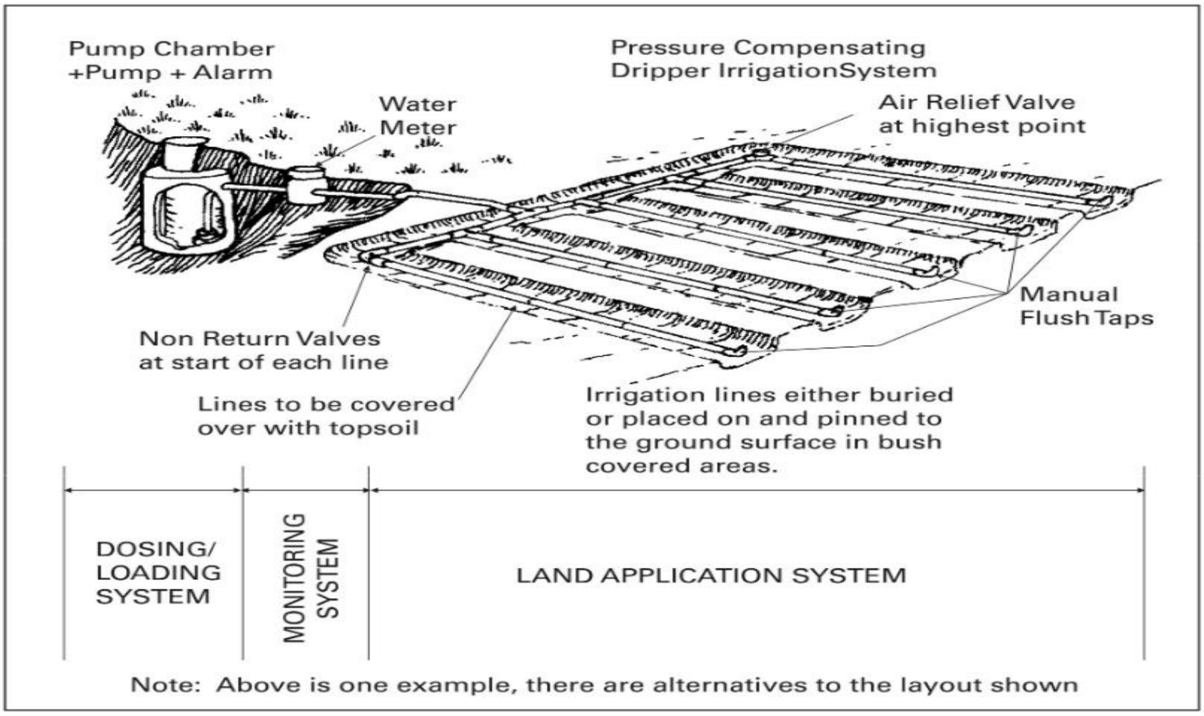

Figure 2: Schematic of a Subsurface Pressure Compensating Dripper Land Irrigation System. Source: Auckland Regional Council TP58 (2004).

Low-pressure irrigation systems (LPED and LPP)

The low-pressure pipe (LPP) and low-pressure effluent distribution (LPED) systems are low-pressure and non-pressure compensating shallow subsurface irrigation systems, designed to retain and further treat wastewater in the topsoil for evapotranspiration and to reduce or slow seepage into the subsoil.

Due to large discharge pipe and orifice diameters (in comparison to those in PCDI systems), they can be used for the application of either primary treated or secondary treated wastewater. For primary treated effluent, a 3mm septic tank outlet filter is recommended.

LPP/LPED systems are not recommended to be installed on sites with a slope greater than, or equal to, 8.5° (15%). Pipes for LPED systems should be laid in 200 x 200 trenches in aggregate of 20 - 40mm, clean and free of soil or organic matter. The dosing system typically consists of a 25 -30mm perforated pipe installed in an 80 -100mm distribution pipe.

Land application area requirements for LPP/LPED systems, as mentioned above, A = Q/DIR, equates to ~ 300m^2 and with a 5m buffer zone surrounding the application area, 400m^2 should be allocated for this type of system. If only primary treatment is provided, then a further 300m^2 reserve area will be required which will require approximately 800m^2 of land area.

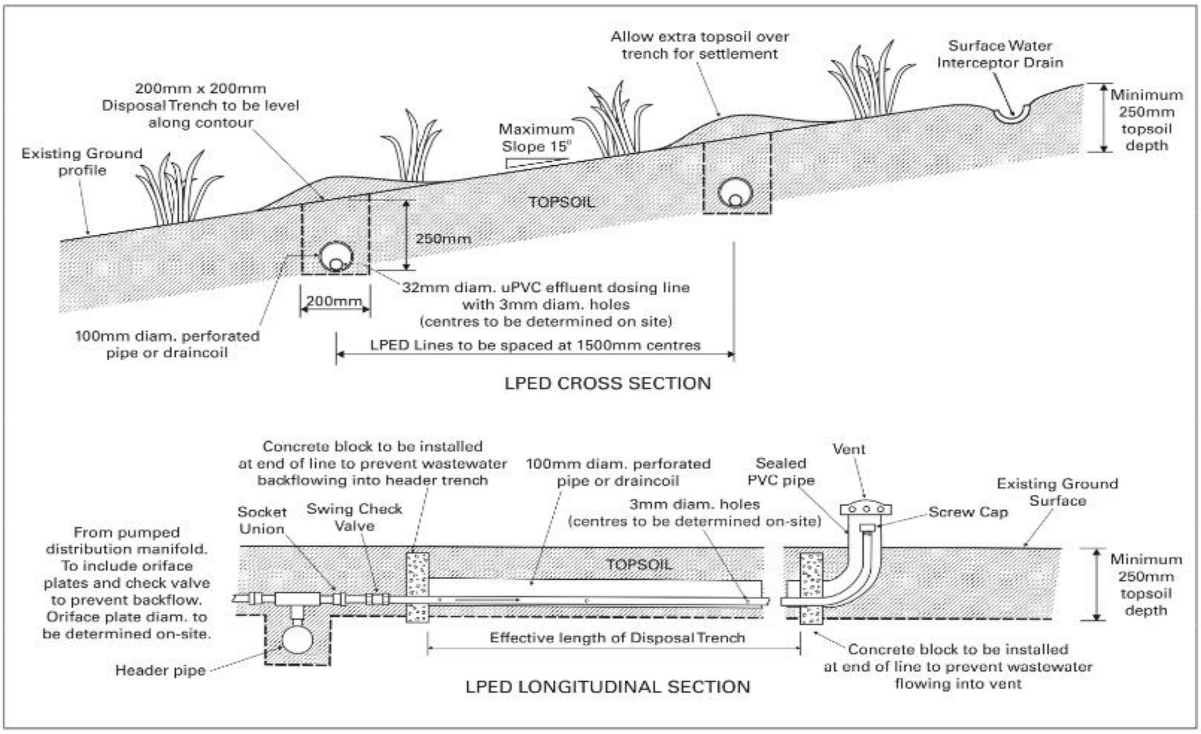

Figure 3: Example of a Shallow LPED Land Application System. Source: Auckland Regional Council TP58 (2004).

9.1.2 Conventional Land Application Systems

Conventional adsorption systems may be used in well-drained areas with low groundwater tables.

For conventional land application systems, trench and bed lengths are calculated as per NZS1547:2012 using the trench or bed length (L), the width of the trench or bed (W), using a conservative design irrigation rate of approximately 10mm/d for trenches and or beds and a wastewater loading rate of 180L/person/day (Q) for 6 people.

L = Q / (DLR * W)

Where:

L- The trench or bed length (m)

Q- Wastewater loading rate (L/d)

W- The width of the trench or bed (m)

DLR- The design loading rate(mm/d)

Trenches.

A trench system is a system of narrow trenches partially filled with aggregate in which a distribution pipe is laid. Trenches require a minimum primary treatment effluent with an effluent outlet filter. Two types of absorption trench field layouts are in common use:

- A distribution box connected to parallel absorption laterals for flat or minimally sloped sites, and;
- A drop box connected to parallel successive trenches along a slope on sites with 5.7° (10%) or greater slopes.

The maximum length of individual absorption lines used in conjunction with gravity distribution is recommended to be 20m. The maximum length of individual absorption lines, used in conjunction with pressure distribution or dosing, is recommended to be 30m.

The land application area required for basal loading only is calculated by Q/DLR = ~110m^2 plus a 100% reserve area and buffer area of 5m totals ~ 250m^2 required.

If secondary or better treatment is provided a less conservative DLR can be used at ~20mm/day would give a required area of ~150m^2 including the required 50% reserve area.

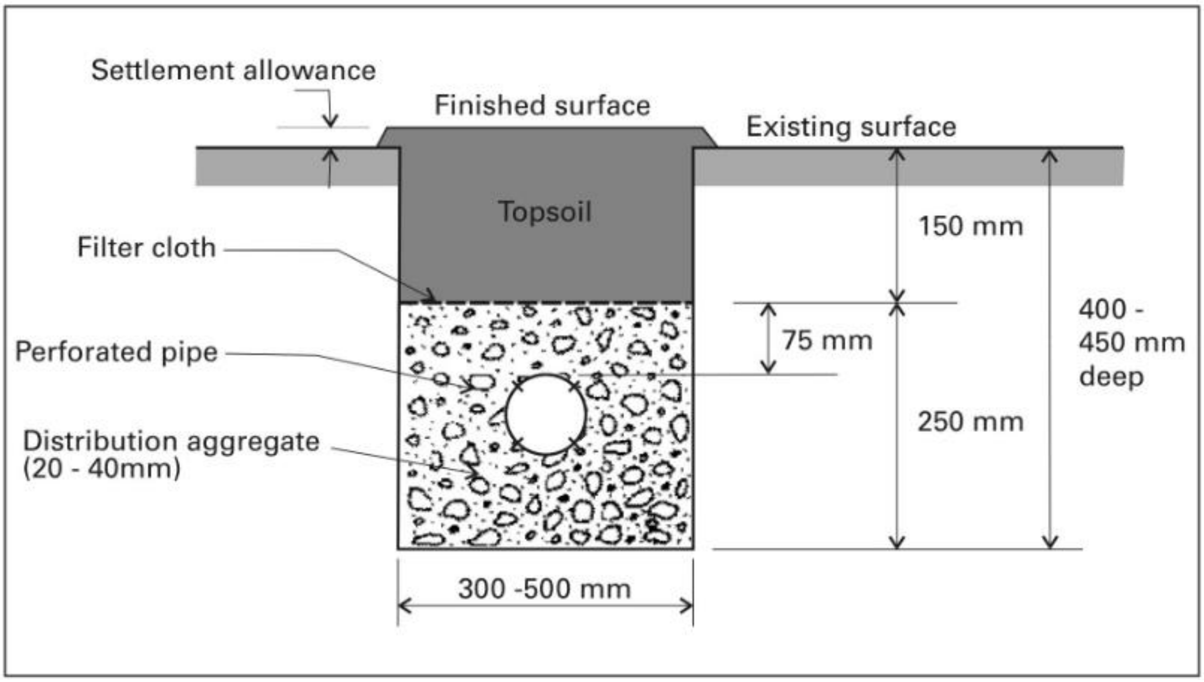

Figure 4: Typical Conventional Trench Detail. Source: Auckland Regional Council TP58 (2004).

Beds

Conventional bed systems are an alternative to trenches especially where the topography and site area are too restrictive for trench installation.

Conventional beds are designed for basal seepage only. Beds have a limited sidewall area compared to trenches and their design loading rate is reduced as the low ratio of sidewall to base area reduces their operational factor of safety, unless they can be laid in suitable soils that will not require imported aggregate, then they can be treated as having sidewall area.

Beds can be suited to soils with low to moderate permeability in well-drained areas with low groundwater tables.

For a typical bed loading rate of 10mm/day, the land application area required for basal loading is calculated by Q/DLR = ~110m^2 plus a 100% reserve area and buffer area of 5m totals ~ 250m^2 required.

As with trenches, if secondary or better treatment is provided a less conservative DLR can be used, at ~20mm/day would give a required area of ~150m^2 including the required 50% reserve area and buffer area.

There is good evidence to indicate both trenches and beds work best if the total design area is split into 2 equal components, which are loaded and rested on an approximate 3 monthly cycle.

Perforated pipe is also available with no holes on the invert which if laid flat can provide a passive means of even dose distribution.

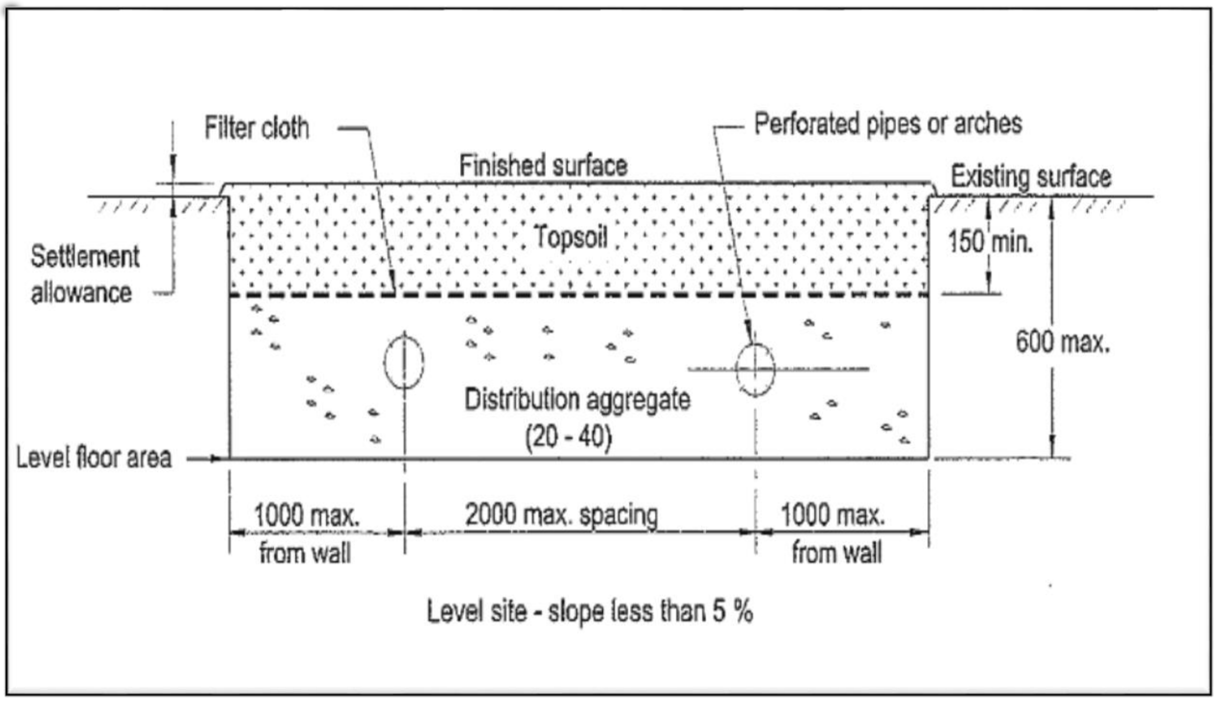

Figure 5: Conventional Bed Disposal Field System.

Mounds

Mound land application systems have been used in the past for soil and site conditions where conventional application trenches are unsuitable due to shallow soils overlying a limiting layer or where water quality protection is required for a high watertable in permeable soils.

The traditional mound provides for the distribution of effluent onto a layer of sand of at least 600mm depth to ensure satisfactory renovation before entering the natural soil and then diffusing into the surrounding soil above the limiting layer or water table. The sand-fill media provides additional treatment of the primary treated wastewater in a similar manner to an intermittent sand filter.

Effluent is usually dose loaded via pumping into the mound distribution system to ensure even distribution across the entire infiltration surface. This also maximises wastewater treatment potential within the sand media to avoid short-circuiting through only a section of the media with resultant ineffectual treatment. Treatment is typically via a minimum 4,500 L septic tank volume with an effluent outlet filter or better.

The location of mounds on steeper slopes increases the risk of wastewater breakout from the downslope edge requiring design of a toe, or toe extension, to assist with assimilation of applied wastewater. Level sites allow wastewater to spread over the infiltration surface under the entire mound area. Mounds should always be located on the upper portion of slopes, not at the slope base.

They can be expensive to construct, and they require a relatively large land area dedicated to wastewater application only, although the entire area is less than that which may be required for PCDI. They are only suitable for gently sloping sites of less than 8.5° (15%).

The anticipated average area required to support a mound system would be ~ 300m^2.

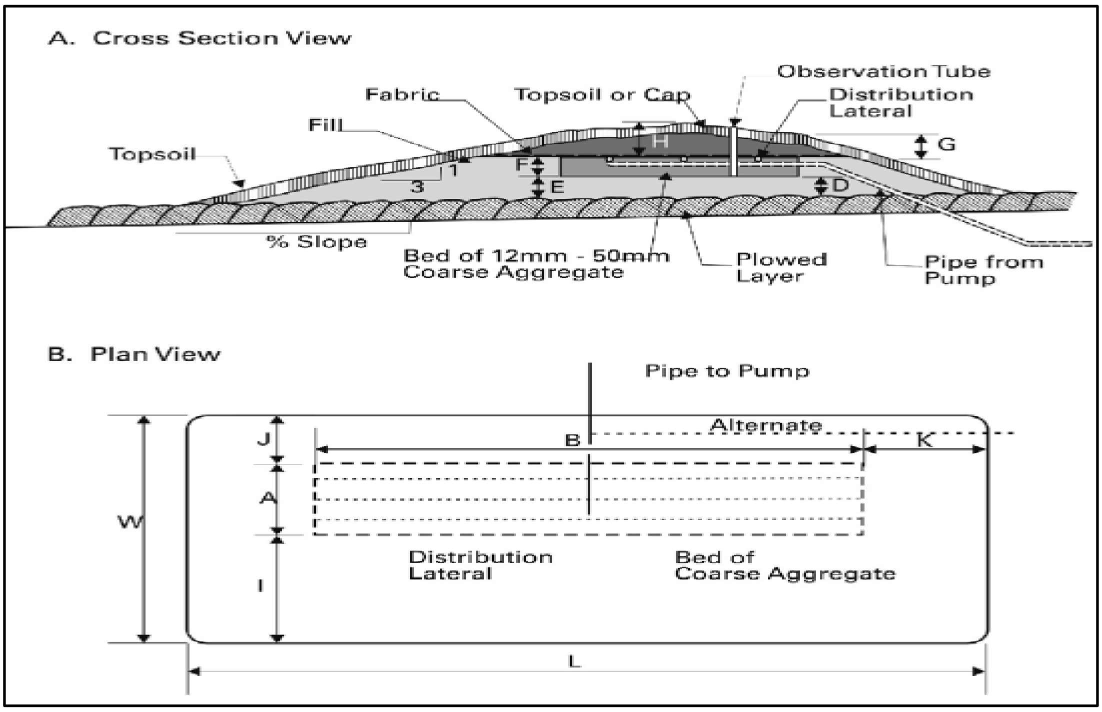

Figure 6: Mound Details for a Flat Site

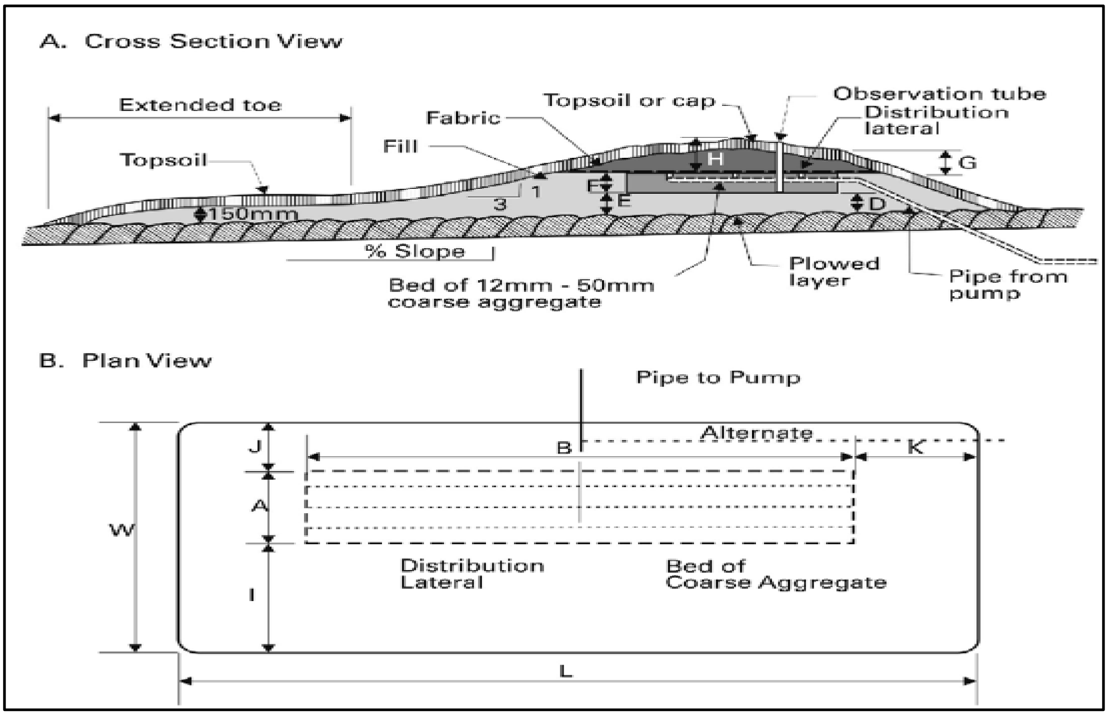

Figure 7: Mound Details for a Sloping Site

10. Rainwater/Stormwater Collection and Storage

A critical issue in rural development design, from a stormwater management perspective, is related to increases in stormwater runoff adversely impacting on the receiving physical environment due to increased flows. Rainwater tanks can provide for extended detention for both domestic water consumption and delayed release which can help maintain stormwater runoff neutrality.

The primary function of water tanks in a rural area is to provide water supply for residential use. In addition to the water supply benefits, water tanks can also reduce the total volume of stormwater runoff by redirecting the runoff to a storage tank for subsequent use for site water needs. In addition to this, many rural properties are located in remote locations and district councils should consider implementing rules regarding water storage capacities to be utilised for firefighting purposes to comply with the NZ Standard for Fire Fighting Water Supplies[5].

Under the NZ Standard for Fire Fighting Water Supplies, dwellings fitted with fire sprinkler systems require 7000L of dedicated firefighting water supply storage whilst dwellings not fitted with sprinkler systems will require 45,000L of water supply storage.

Water storage volumes on rural lots should cater for domestic use, provide enough storage to maintain supply during times of low rainfall and also maintain enough reserve water for emergency firefighting requirements.

Most of the proposed rural expansion areas of Upper Hutt receive around 1400mm of rain per year. In Upper Hutt, reticulated supply domestic water consumption is currently averaging 215 litres per person per day[6].

To provide adequate storage for domestic use and adequate firefighting supply whilst also utilising water tanks as a detention system to maintain pre and post development stormwater runoff neutrality, it is estimated that for an average new rural domestic development an area set aside for 120,000L of storage/detention should be provided.

An average 30,000L water tank has a 4m diameter. Four tanks, with spacing of ~0.5m between would require ~100m^2 in area.

11. Stormwater Discharge

Critical issues in rural development design, from a stormwater management perspective, are related to increases in stormwater runoff adversely impacting on the receiving system physical structure. As such, the extended detention of flows to minimise downstream channel erosion is an important issue.

A key difference in calculating stormwater runoff from rural properties versus urban ones is that significant site regrading is minimised in rural areas and there is typically little change to pervious area predevelopment runoff coefficients for most of the site. If the impervious surface volume is reduced or mitigated from a peak flow perspective, receiving system stability can be maintained.

With stormwater detention proposed as described in Section 10, anticipated stormwater discharge would predominantly occur from the buffer storage in the tanks to match the predevelopment flow rate.

Dependant on site conditions and the local environment, stormwater overflow may be able to discharge to nearby water courses and natural topographic flow paths. If this is not an appropriate option, some land types will allow soakage pits or beds to be utilised as a disposal option.

If soakage pits are used, typically buffer storage is not required and the pit will be designed to accommodate the 10 year return storm event.

Soak pits are only a viable option in areas where the ground has moderate to high permeability with a relatively low watertable and flat to gently sloping topography.

[5] SNZ PAS 4509:2008 – New Zealand Fire Service Firefighting Water Supplies Code of Practice

[6] www.upperhuttcity.com/Services/Water/Water-conservation

A typical soakage pit basal area in permeable soils is ~5m^2 with varying depths dependant on site conditions.

For sites where soakage pits are not appropriate, as can be in steeper sites, a natural topographic drainage path will be available and will need to be considered at the time of subdivision so as to ensure all lots have the right to discharge to it at a neutral rate in comparison to predevelopment runoff.

12. Setback Distances

Setback distances between land application system components and site features (such as property boundaries, structures [existing or planned], waterways etc.) are required to maintain performance and allow for repairs/maintenance. In addition, land application system effluent contains potentially pathogenic micro-organisms, dissolved nutrients and chemicals capable of traveling long distances if they reach the groundwater. To minimize the possible health hazard and pollution potential of treated effluent, land application areas should be located well above the seasonal high groundwater level and as far as possible from drinking water supplies and surface waters.

The site features that need to be considered include; property lines, water supplies, wetlands, watercourses, buildings and utilities, etc. (Table 3). Proximity to any ecologically sensitive or high amenity value receiving environment should also be carefully evaluated.

The wastewater treatment unit must comply with the Building Code and should be a minimum of 1.5m distance from other downslope structures.

When designing a land application system, consideration should also be given to:

- Preventing any future home improvements/developments from impacting, or damaging, the operation of the land application area;
- Maintaining the reserve land application area in a condition that does not impede its use for wastewater discharge if required in future (i.e. the area shall not be sealed or used for vehicle parking, buildings, driveways or any other form of development)

The minimum setback distances from the edge of a wastewater land application area to edge of site feature for different effluent treatment levels is provided in Table 3 below.

It should also be noted that greater setback distances may be required in new subdivisions to mitigate cumulative effects.

The risks from cumulative effects generally needs to be considered when there is more than one onsite wastewater system per 5,000m^2. Cumulative effects may result from the intensification and clustering of on-site wastewater disposal systems. Such effects can result in the degradation of groundwater and downstream catchment quality.

To mitigate against cumulative effects of multiple discharge systems, a conservative design approach is crucial. Designing for a high quality treated effluent and a conservative soil loading rate will be required and should be considered at the time of any subdivision or development.

Table 3: Wastewater disposal field setback distances.

Site feature	Primary treated (septic tank and effluent filter)	Secondary treated	Advanced secondary treated (e.g. packed bed reactor)	Tertiary treated (disinfection)	Advanced tertiary treatment (nutrient reduction and disinfection)
Groundwater	1.5 m	1m	0.6m	0.6m	0.6m
Buildings or houses	3.m	1.5m – 3m	1.5m – 3m	1.5m – 3m	1.5m – 3m
Property boundaries	20m	5m	5m	5m	5m
Surface water body, coastal marine area,	20m	20m	20m	20m	20m
bore used for water abstraction for potable supply	50m	50m	50m	50m	50m

System	To dwelling	To Wastewater field	To water Tanks	To septic Tanks	To Boundary
Soakage pit	2m	5m	2m	2m	1.5m

13. Matrix Assessment

The following provides an overall assessment of the minimum required areas need to provide for rural onsite 3 waters servicing in relation to land types, wastewater disposal and treatment types and also factoring in minimum setback distances and areas required for water storage and discharge.

The assessment provides general servicing area requirements at a district scale. Many site specific factors could allow variations from the assessed area requirements and these should be taken as a general guide only.

Cumulative effects also need to be considered in cases where a number of separate on-site systems are located in close proximity. Numerous systems operating in close proximity pose a greater potential risk to the receiving environment. Such effects also have not been specifically factored into this assessment.

Table 4 below shows the recommended minimum service areas required to accommodate onsite wastewater disposal, stormwater disposal and rainwater collection per Lot.

Minimum service area requirements are based on individual Lots requiring stormwater soakage pits, as disposal to stream does not require any land, area required to house water storage tanks, onsite wastewater discharge areas, including reserve areas when required, and required setback distances from boundaries and dwellings.

N/A shown in Table 4 denotes that this type of land application system ascribed is not suitable for the rural land type classified.

Table 4: Minimum services area assessment

Rural Land Type	Wastewater Disposal System	Wastewater Treatment	Water Tanks # Required	Stormwater Discharge	Minimum Services area required
1 **Gravels / Gravel deposits on flat to low gradient**	Conventional Land Application Systems Shallow Irrigation Systems	Primary Secondary Secondary	4	Soakpit	N/A 800m^2
2 **Alluvium (Q1-Q4) flat to low gradient**	Conventional Land Application Systems Shallow Irrigation Systems	Primary Secondary Secondary	4	Soakpit	400m^2 300m^2 800m^2
3 **Peat / Swamp**	Conventional Land Application Systems Shallow Irrigation Systems	Primary Secondary Secondary	4	Soakpit	N/A 800m^2
4 **Alluvium (Q5-Q11) on moderate slope (<26°)**	Conventional Land Application Systems Shallow Irrigation Systems	Primary Secondary Secondary	4	Soakpit	400m^2 300m^2 800m^2
5 **Sandy silt (1-5m) over bedrock / Overburden soils (2-4m) over bedrock on >26° slopes and hilltops**	Conventional Land Application Systems Shallow Irrigation Systems	Primary Secondary Secondary	4	Soakpit	N/A 800m2 1000m2

14. Conclusion

Sites created by subdivision need to be of a sufficient size to enable servicing requirements to be met. Allocating adequate areas for 3 waters requirements will minimise the environmental impacts of rural subdivisions.

In determining minimum rural Lot sizes, the serviceability of the land and servicing requirements of a site provide an additional factor to be considered. Though there are many other factors that will contribute to the determination of a minimum Lot size required for rural domestic development, this assessment aims to provide council with the typical area needed to provide for the servicing described for each of the rural land type system options designated in Table 4.