SITE ASSESSMENT AND DESIGN EXERCISE

For this exercise we will work in small groups to complete a site assessment and design exercise for an on-site wastewater system.

Step One - Fieldwork

Use the **Soil Survey Sheet** and **Appendix 2** (below) to record details of your site and soil assessment.

Auger a hole and lay the soil out carefully to represent a soil profile. Excavate a soil pit adjacent to the auger hole and note how much more clear a picture you obtain of the soil profile by digging a soil pit.

Use the skills you have learned earlier to assess the soil texture by hand and feel for each horizon (layer) you can distinguish in the soil profile. Compile this information and the results of the other soils investigations listed on the table (Appendix 2).

(i) What is the **'texture and structure'** of the limiting soil horizon or constraint in the identified effluent land application area (LAA)?

____

Remember: Minimum vertical separation to limiting condition is 0.5m (AS/NZS 1547:2012)

(ii) Is it possible to mitigate the limiting condition identified? How might you do that?

____

Step Two – Design Conditions

Assume that you are designing an OSSM system for a **three-bedroom** dwelling with reticulated water supply, to be **occupied by five people**, which is to be constructed on the Site you have just investigated.

(iii) What is the **'design occupancy'** and **'design hydraulic load'** for the dwelling?

____

TABLE H1
TYPICAL DOMESTIC WASTEWATER DESIGN FLOW ALLOWANCES – AUSTRALIA

Source	Typical wastewater design flows (L/person/day)	
Residential premises	On-site roof water tank supply	Reticulated water supply
	120	150

Source: Australian Bureau of Statistics. Water Account 2004/2005. Chapter 7 Figure 7.3

Step Three – Preliminary LAA Sizing

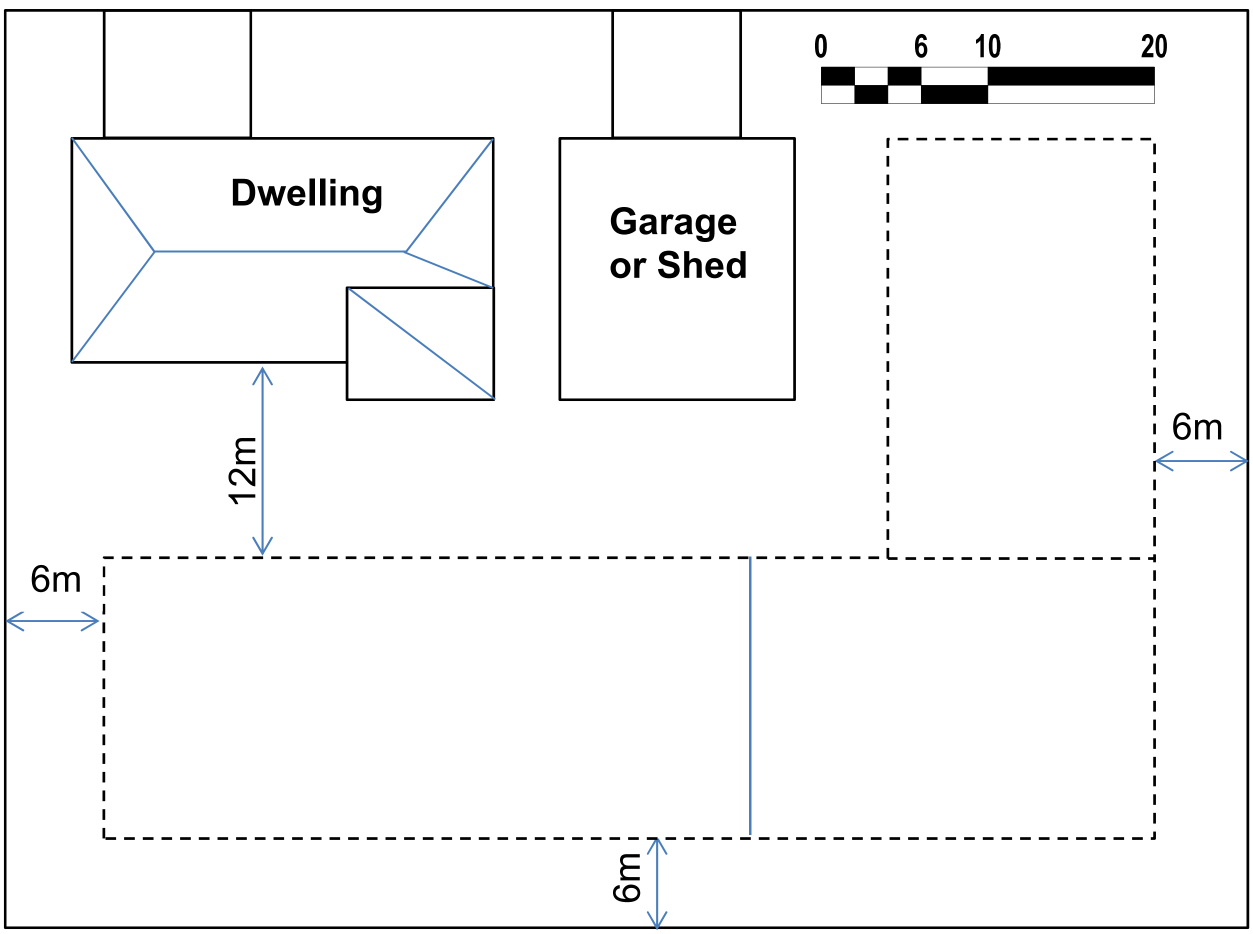
AS/NZS 1547:2012 supports a simple sizing methodology for effluent land application systems based on an **'areal loading'** rate calculation.

$$\mathbf{A}\ (m^2) = \mathbf{Q}\ (L)\ /\ \textbf{soil loading rate}\ (DLR, DIR, BLR)\ (mm/day)$$

(iv) To give you an idea of the relative land area requirements for a range of LAA systems, use the appropriate table from AS/NZS 1547:2012 (provided on following pages) to determine the correct (soil) loading rate and minimum system area required.

LAA System Type	Loading Rate (mm/day)	Minimum Size (m^2)
Trench/bed		
ETA		
Mound		
Irrigation area		

(v) On the example Site Plan (below), sketch out how each LAA configuration might be arranged for your Site.



Step Four – Final Design Solution

(vi) Discuss amongst your group and decide upon the **'most suitable'** on-site system for the Site we have visited.

Treatment System: (Primary / Secondary) Why? ___________________________________

LAA System: ____

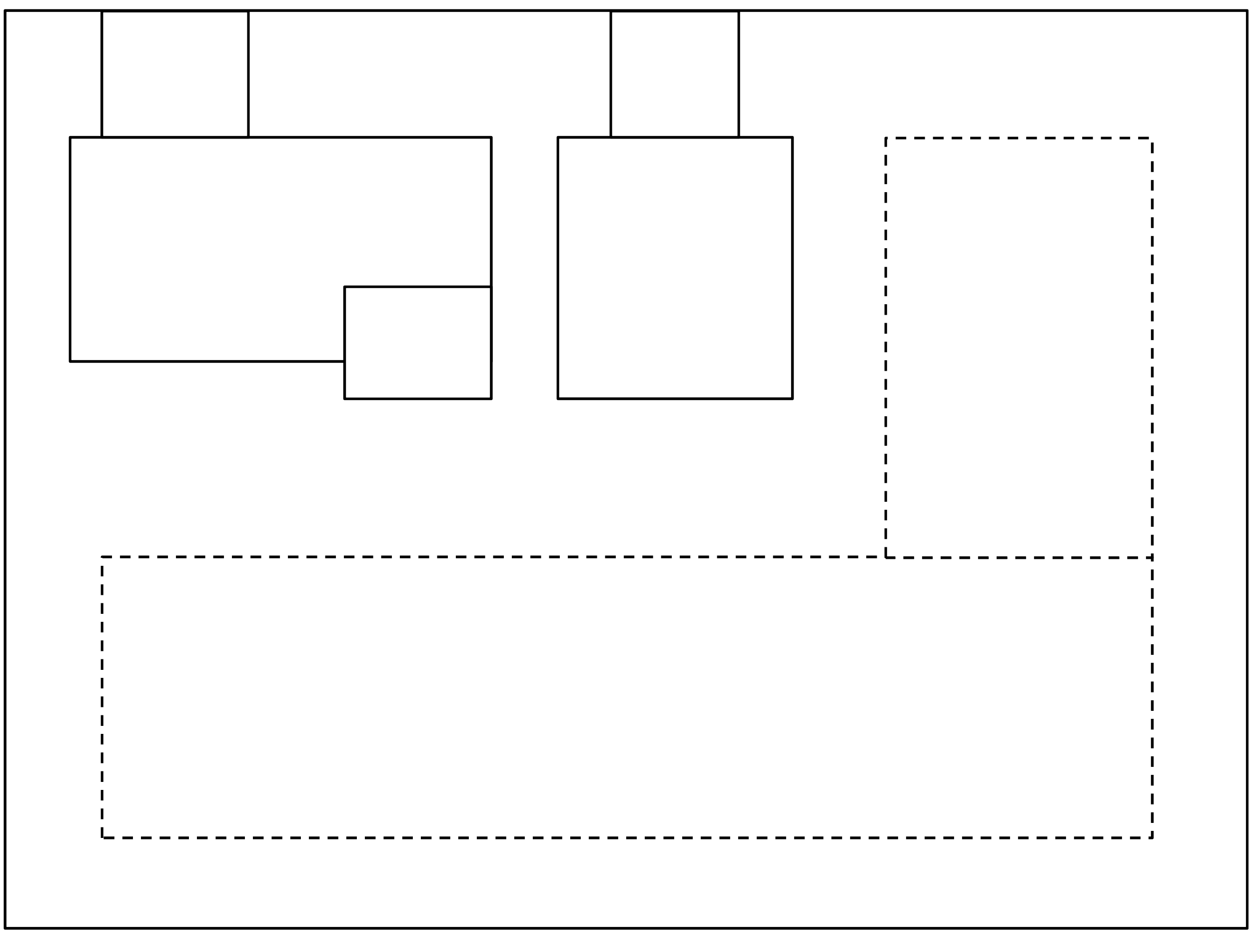
Applicable Soil Loading Rate: (mm/day) ____

Mitigation proposed: (What/Why?) ____

____

(vii) Prepare a case to justify your system selection and determine the appropriate sizing for your system.

LAA required (m^2): ____



Each group will have an opportunity to present their design and will be expected to rationalise how they have reached their conclusions.

TABLE L1
RECOMMENDED DESIGN LOADING RATES FOR TRENCHES AND BEDS

Soil category	Soil texture	Structure	Indicative permeability (K_{sat})(m/d)	Design loading rate (DLR) (mm/d)			
				Trenches and beds			ETA/ETS beds and trenches
				Primary treated effluent		Secondary treated effluent	
				Conservative rate	Maximum rate		
1	Gravels and sands	Structureless (massive)	> 3.0	20 (see Note 1)	35 (see Note 1)	50 (see Note 1)	(see Note 4)
2	Sandy loams	Weakly structured	> 3.0	20 (see Note 1)	30 (see Note 1)	50 (see Note 1)	
		Massive	1.4 – 3.0	15	25	50	
3	Loams	High/ moderate structured	1.5 – 3.0	15	25	50	
		Weakly structured or massive	0.5 – 1.5	10	15	30	
4	Clay loams	High/ moderate structured	0.5 – 1.5	10	15	30	12
		Weakly structured	0.12 – 0.5	6	10	20	8
		Massive	0.06 – 0.12	4	5	10	5
5	Light clays	Strongly structured	0.12 – 0.5	5	8	12	8
		Moderately structured	0.06 – 0.12	(see Notes 2 & 3)	5	10	5 (see Notes 2, 3, & 5)
		Weakly structured or massive	< 0.06			8	
6	Medium to heavy clays	Strongly structured	0.06 – 0.5				
		Moderately structured	< 0.06				
		Weakly structured or massive	< 0.06				

NOTES:

1 The treatment capacity of the soil and not the hydraulic capacity of the soil or the growth of the clogging layer govern the effluent loading rate in Category 1 and weakly structured Category 2 soils. Land application systems in these soils require design by a suitably qualified and experienced person, and distribution techniques to help achieve even distribution of effluent over the full design surface (see L6.2 and Figure L4 for recommended discharge method by discharge control trench). These soils have low nutrient retention capacities, often allowing accession of nutrients to groundwater.

2 To enable use of such soils for on-site wastewater land application systems, special design requirements and distribution techniques or soil modification procedures will be necessary. For any system designed for these soils, the effluent absorption rate shall be based upon soil permeability testing. Specialist soils advice and special design techniques will be required for clay dominated soils having dispersive (sodic) or shrink/swell behaviour. Such soils shall be treated as Category 6 soils. In most situations, the design will need to rely on more processes than just absorption by the soil.

3 If K_{sat} < 0.06 m/d, a full water balance for the land application can be used to calculate trench/bed size (see Appendix Q).

4 ETA/ETS systems are not normally used on soil Categories 1 to 3.

5 For Category 6 soils ETA/ETS systems are suitable only for use with secondary treated effluent.

(Source: AS/NZS 1547:2012 Standards Australia)

TABLE M1
RECOMMENDED DESIGN IRRIGATION RATE (DIR) FOR IRRIGATION SYSTEMS

Soil Category (see Note 1)	**Soil texture**	**Structure**	**Indicative permeability** (K_{sat}) (m/d)	**Design irrigation rate (DIR)** (mm/day)		
				Drip irrigation	**Spray irrigation**	**LPED irrigation**
1	Gravels and sands	Structureless (massive)	> 3.0	5 (see Note 2)	5	(see Note 3)
2	Sandy loams	Weakly structured	> 3.0			4
		massive	1.4 – 3.0			
3	Loams	High/ moderate structured	1.5 – 3.0	4 (see Note 1)	4	3.5
		Weakly structured or massive	0.5 – 1.5			
4	Clay loams	High/ moderate structured	0.5 – 1.5	3.5 (see Note 1)	3.5	3
		Weakly structured	0.12 – 0.5			
		Massive	0.06 – 0.12			
5	Light clays	Strongly structured	0.12 – 0.5	3 (see Note 1)	3	2.5 (see Note 4)
		Moderately structured	0.06 – 0.12			
		Weakly structured or massive	< 0.06			
6	Medium to heavy clays	Strongly structured	0.06 – 0.5	2 (see Note 2)	2	(see Note 3)
		Moderately structured	< 0.06			
		Weakly structured or massive	< 0.06			

NOTES:

1 For Category 3 to 5 soils (loams to light clays), the drip irrigation system needs to be installed in an adequate depth of topsoil (in the order of 150 – 250 mm of *in situ* or imported good quality topsoil) to slow the soakage and assist with nutrient reduction.

2 For Category 1, 2, and 6 soils, the drip irrigation system has a depth of 100 – 150 mm in good quality topsoil (see CM1 and M3.1).

3 LPED irrigation is not advised for Category 1 or Category 6 soils – drip irrigation of secondary effluent is the preferred irrigation method.

4 LPED irrigation for Category 5 soils needs a minimum depth of 250 mm of good quality topsoil (see M5 and CM7.1).

(Source: AS/NZS 1547:2012 Standards Australia)

TABLE N1
RECOMMENDED MOUND DESIGN LOADING RATES

Soil Category	Soil texture	Structure	Indicative permeability (K_{sat})(m/d)	Design loading rate (DLR) (mm/d)
1	Gravels and sands	Structureless (massive)	> 3.0	32
2	Sandy loams	Weakly structured	> 3.0	24
		Massive	1.4 – 3.0	24
3	Loams	High/ moderate structured	1.5 – 3.0	24
		Weakly structured or massive	0.5 – 1.5	16
4	Clay loams	High/ moderate structured	0.5 – 1.5	16
		Weakly structured	0.12 – 0.5	8
		Massive	0.06 – 0.12	5 (see Note)
5	Light clays	Strongly structured	0.12 – 0.5	8
		Moderately structured	0.06 – 0.12	5 (see Note)
		Weakly structured or massive	< 0.06	
6	Medium to heavy clays	Strongly structured	0.06 – 0.5	
		Moderately structured	< 0.06	
		Weakly structured or massive	< 0.06	

NOTE: To enable use of such soils for on-site wastewater land application, special design requirements and distribution techniques or soil modification procedures will be necessary. For any system designed for these soils, the effluent absorption rate shall be based upon soil permeability testing. Specialist soils advice and special design techniques will be required for clay dominated soils having dispersive (sodic) or shrink/swell behaviour. Such soils shall be treated as Category 6 soils. In most situations, the design will need to rely on more processes than just absorption by the soil.

(Source: AS/NZS 1547:2012 Standards Australia)

SOIL SURVEY SHEET

Landscape (description) Site No.........................

Geology		Surface drainage	
Vegetation		Internal drainage	
Aspect		Groundwater	
Slope (%)			

Buffer distances (all distances in metres, upslope or downslope)

Sketch house on the lot	Surface water storage	Groundwater bore or well
	Other buildings	Swimming pool
	Property boundary - upslope	Property boundary - down slope

Profile Description (section numbers refer to Chapter 7 notes)

Soil horizon 6.2.1	depth (mm) from - - - to	boundary type 6.2.3	field texture 6.2.4	structure -shape, grade, size 6.2.5	pH (units) Exercise 3	EC (dS/m) Exercise 2	dominant colour - moist 6.2.6	mottles 6.2.7	dispersion Exercise 1	coarse fragments 6.2.15
top										
second										
third										

Recorder .... Date ....

APPENDIX 2
MODEL SITE REPORT

1 SITE EVALUATORS	
Company	Name(s)
Address	
ph:	fax:
Date of assessment: / /	Signature of evaluator: / /

2 SITE INFORMATION	
Address/locality of site	Council area
Owner/developer:	ph:
Address:	
Size/shape/layout Site plans attached Photograph attached	 yes/no
Intended water supply	rainwater reticulated water supply bore/groundwater
Expected wastewater quantity (litres/day)	
Local experience (information attached regarding on-site sewage management systems installed in the locality)	yes/no

If any site or soil features have not been assessed, note why.

3 SITE ASSESSMENT	
Climate Are low temperatures expected (particularly below 15°C)?	yes/no
Where appropriate: Rainfall water balance attached Land application area calculation attached Wet weather storage area calculation attached	 yes/no yes/no yes/no
Flood potential Land application area above 1 in 20 year flood level Land application area above 1 in 100 year flood level Electrical components above 1 in 100 year flood level	 yes/no yes/no yes/no
Exposure	
Slope	
Landform	
Run-on and seepage	
Erosion potential	
Site drainage	
Fill	
Groundwater Horizontal distance to groundwater well used for domestic water supply (m) Relevant groundwater vulnerability map referred to? Level of protection (I – VI) Bores in the area and their purpose:	 yes/no/not available
Buffer distances from wastewater Management system to: Permanent waters (m) Other waters (m) Other sensitive environments (m) Boundary of premises (m) Swimming pools (m) Buildings (m)	
Is there sufficient land area available for: Application system (including buffer distances) Reserve application system (including buffer distances)	 yes/no yes/no
Surface rocks	

4 SOIL ASSESSMENT
Depth to bedrock or hardpan (m)
Depth to high soil watertable (m)
Hydraulic loading rate (where applicable) Soil structure: Soil texture: Permeability category: Other measures of soil permeability: Hydraulic loading recommended for soil absorption system (mm/day): Reasons for the hydraulic loading recommendation:
Coarse fragments (%)
Bulk density (and texture) (g/cm^3)
pH
Electrical conductivity (dS/m)
Exchangeable sodium percentage
Cation exchange capacity ($cmol^+/kg$)
Phosphorus sorption index
Geology & soil landscape survey Presence of discontinuities Presence of fractured subsoil Soil and Landscape map reference:
Dispersiveness

5 SYSTEM SELECTION	
Consideration of connection to a centralised sewerage system Approximate distance to nearest feasible connection point: Potential for future connection to centralised sewerage Potential for future connection to reticulated water	 high/med/low high/med low/already connected
Type of land application system considered best suited to site: Why?	
Type of treatment system considered best suited to site and application system: Why?	

6. GENERAL COMMENTS
Are there any specific environmental constraints?
Are there any specific health constraints?
Any other comments?

Calculation of evapotranspiration-absorption area size by water balance method

Size of area for each month

(1) Month	(2) Pan evaporation E mm	(3) Evapo transpiration ET ET = 0.75E mm	(4) Rainfall R mm	(5) Retained rainfall R_r $R_r = 0.75R$ mm	(6) DLR per month mm	(7) Disposal rate per month (3)-(5)+(6) mm	(8) Effluent applied per month L	(9) Size of area (8)/(7) m^2
Jan								
Feb								
Mar								
Apr								
May								
Jun								
Jul								
Aug								
Sep								
Oct								
Nov								
Dec								
First trial area = average monthly area =								m^2

Depth of stored effluent (first trial)

(1) Month	(2) First trial area m^2	(3) Application rate (8)/(2) mm	(4) Disposal rate per month (7) mm	(5) (3) - (4) mm	(6) Increase in depth of stored effluent (5)/n mm	Depth of effluent for month (X - 1) mm	(7) Increase in depth of effluent + (6) mm	Computed depth of effluent month (X) mm
Dec		-	-	-	-	0		
Jan								
Feb								
Mar								
Apr								
May								
Jun								
Jul								
Aug								
Sep								
Oct								
Nov								
Dec								

n = effective void space factor. For imported durable aggregate, n = 0.3