WATER BALANCE ANALYSIS WORKSHOP SESSION
WORKED EXAMPLE

Calculation of evapotranspiration-absorption/seepage area size by the water balance method.

Using the following information using your Course Notes, calculate the minimum area and depth of an evapotranspiration-absorption/seepage area for a three bedroom / five person dwelling.

Bureau of Meteorology rainfall and pan evaporation data for the nearest station (Perth Airport) is provided below.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
DAILY PAN EVAPORATION (mm)	10.2	9.6	7.7	5.0	3.0	2.2	2.1	2.6	3.7	5.4	7.5	9.1
MEAN MONTHLY RAINFALL (mm)	11.1	14.9	16.0	40.0	97.4	155.7	156	119.0	72.7	43.2	25.6	11.3

Three test pits excavated on the proposed disposal area indicate that the soils are 475mm weakly structured clay loam overlying moderately structured light clay to a depth of 2000mm. Use the recommended design loading rate derived from Table L1 of AS/NZS 1547:2012 (see the Field Workshop and Design Exercise section of these Course Notes).

Calculate the evapotranspiration-absorption/seepage area using the worksheets provided on the following two pages.

The evapotranspiration-absorption area is to be constructed of imported aggregate, is to have a maximum depth of 600mm with a minimum of 50mm freeboard (i.e. maximum depth of stored effluent is 550mm).

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

Size of area for each month								
1	2	3	4	5	6	7	8	9
Month	Pan Evaporation	Evapotranspiration	Rainfall	Retained Rainfall	DLR	Disposal Rate	Applied Effluent	Size of area
	E	ET	R	Rr	per month	per month	per month	
		ET = 0.75E		Rr = 0.75R		(3)-(5)+(6)		(8)/(7)
	mm	mm	mm	mm	mm	mm	L	m^2
Jan	316.2	237.2	11.0	8.3	155	383.9	18600	48.5
Feb	268.8	201.6	14.9	11.2	140	330.4	16800	50.8
Mar	238.7	179.0	16.0	12.0	155	322.0	18600	57.8
Apr	150.0	179.0	40.0	30.0	150	299.0	18000	60.2
May	93.0	112.5	97.4	73.1	155	194.5	18600	95.7
Jun	66.0	69.8	155.7	116.8	150	103.0	18000	174.8
Jul	65.1	49.5	156.0	117.0	155	87.5	18600	212.6
Aug	80.6	48.8	119.0	89.3	155	114.6	18600	162.3
Sep	111.0	60.5	72.7	54.5	150	155.9	18000	115.4
Oct	167.4	83.3	43.2	32.4	155	205.9	18600	90.4
Nov	225.0	125.6	25.6	19.2	150	256.4	18000	70.2
Dec	282.1	168.8	11.3	8.5	155	315.3	18600	59.0
First trial area = average monthly area m^2								**99.8**

Depth of stored effluent										
1	2	3	4	5	6		7			
Month	First trial area	Application rate	Disposal Rate		Increase in depth of stored effluent	Depth of effluent for month	Increase in depth of effluent	Computed depth of effluent		
			per month		per month		per month	month X		
		(8)/2)	(7)	(3)-(4)	(5)/n (void space ratio)	(X - 1)	+ (6)			
	m^2	mm	mm	mm	mm	mm	mm	mm		
Jan	99.8	186.4	383.9	-197.5	-658.4	0.0	-658.4	0.0		
Feb		168.3	330.4	-162.1	-540.3	0.0	-540.3	0.0		
Mar		186.4	322.0	-135.7	-452.2	0.0	-452.2	0.0		
Apr		180.4	299.0	-118.7	-395.6	0.0	-395.6	0.0		
May		186.4	194.5	-8.1	-26.9	0.0	-26.9	0.0		
Jun		180.4	103.0	77.4	257.9	0.0	257.9	257.9		
Jul		186.4	87.5	98.9	329.6	257.9	329.6	587.5		
Aug		186.4	114.6	71.8	239.3	587.5	239.3	826.8		
Sep		180.4	155.9	24.4	81.4	826.8	81.4	908.3		
Oct		186.4	205.9	-19.5	-64.9	908.3	-64.9	843.3		
Nov		180.4	256.4	-76.0	-253.3	843.3	-253.3	590.0		
Dec		186.4	315.3	-128.9	-429.7	590.0	-429.7	160.3		

Values >550mm so need to adjust First trial area s ize to reduce to <550mm.

Depth of stored effluent										
1	2	3	4	5	6		7			
Month	First trial area	Application rate	Disposal Rate		Increase in depth of stored effluent	Depth of effluent for month	Increase in depth of effluent	Computed depth of effluent		
			per month		per month		per month	month X		
		(8)/2)	(7)	(3)-(4)	(5)/n (void space ratio)	(X - 1)	+ (6)			
	m^2	mm	mm	mm	mm	mm	mm	mm		
Jan	120.0	155.0	383.9	-228.9	-763.0	0.0	-763.0	0.0		
Feb		140.0	330.4	-190.4	-634.8	0.0	-634.8	0.0		
Mar		155.0	322.0	-167.0	-556.8	0.0	-556.8	0.0		
Apr		150.0	299.0	-149.0	-496.8	0.0	-496.8	0.0		
May		155.0	194.5	-39.5	-131.5	0.0	-131.5	0.0		
Jun		150.0	103.0	47.0	156.8	0.0	156.8	156.8		
Jul		155.0	87.5	67.5	225.0	156.8	225.0	381.8		
Aug		155.0	114.6	40.4	134.8	381.8	134.8	516.5		
Sep		150.0	155.9	-5.9	-19.7	516.5	-19.7	496.8		
Oct		155.0	205.9	-50.9	-169.5	496.8	-169.5	327.3		
Nov		150.0	256.4	-106.4	-354.5	327.3	-354.5	0.0		
Dec		155.0	315.3	-160.3	-534.3	0.0	-534.3	0.0		

Trial area increased to 120m2 brings computed depth to <550mm.