STORM_CONSULTING

21 November 2008

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_ANALYSIS
_CONSENSUS
_DESIGN
_MANAGEMENT

Dear David,

RE: Addendum to Grandfathers Gully Water Cycle management report

Background

A review *"review"* of the Water Cycle Management Report *"report"* for the rural residential development of Lot 2 DP 250984 was commissioned by the Department of Planning (DoP) and undertaken by Whitehead and Associates.

The *review* identifies a number of issues in relation to the proposed On-Site Wastewater Management Scheme for the site, the most critical being the selection of climate data used, the available area for nutrient disposal and the design and management measures required for highly constrained lots (steep slopes, medium to heavy clays and shallow soils).

We have reviewed these issues and have updated the water balance model to incorporate updated climate information, amended the lot layout, amended the effluent loading rates and amended the disposal areas to provide a more conservative approach across the site.

It should be noted that the *review* agrees in principle with the suitability of sub-surface irrigation as a disposal method for the site.

The purpose of the original *report* and this addendum is to demonstrate the feasibility of on-site effluent disposal for the proposed subdivision layout. The *report* has not been amended. This addendum is to be read in conjunction with section 2 of the *report*.

On site wastewater assessment and design parameters

Site Soil Assessment

No further site soil analysis has been undertaken. As a conservative approach we have assumed that poorly drained medium to heavy clays extend over the whole site. Further site soil analysis will be necessary as part of individual development assessments for individual sites. It may be found that soils have a higher infiltration capacity, and as such smaller irrigation areas may be feasible.

Effluent loading rates

A loading rate of 805L/d has been maintained from the *report*. The *review* agreed with this assumption

Effluent treatment

A secondary level of treatment is recommended. An secondary level Aerated Wastewater Treatment System (AWTS) is recommended that achieves a minimum nutrient removal of 30mg/L for total nitrogen and 12mg/L for total phosphorous. A biolytix system is no longer recommended.

The effluent treatment systems suggested in the *report* are recommended.

Effluent disposal

Two types of disposal system were originally recommended over the site. We have now based our assessment on sub-surface irrigation for all lots, with options for mounds where appropriate in the less steep areas. The *review* agrees in principle with the use of sub-surface irrigation as an effluent disposal method on the site (Whitehead and Associates, p7). Where necessary we have identified buffer distances to dams and drainage lines. These distances are specified as flow path distances, ie. distances to the watercourse measured perpendicular to contours.

AS1547:2000 recommends that for sites with low permeability soils; mounds, trenches or irrigation systems may be used where designed with a water balance analysis (AS1547:2000, Table 4.2B2, 2000). Irrigation needs to be sub-surface as sites are generally too steep for surface irrigation.

Effluent irrigation rates

The *report* assumed a range of effluent loading rates over the site. We have now adjusted these loading rates to the lowest recommended value for sub-surface irrigation systems for medium to heavy clays for the whole site of 15mm/wk.

Water balance and nutrient balance modelling

The *review* suggested more relevant climate data than that provided by Eurobodalla Council in their guideline. We have amended the water balance to include rainfall data from the Catalina Country Club and also to use the lowest recommended design irrigation rate of 15mm/wk.

A nutrient balance has been calculated for all lots. As the *review* suggests the limiting nutrient is nitrogen. The minimum area required for the sustainable management of nitrogen is 966m^2 based on a secondary treatment system that is able to achieve a nitrogen removal rate of 30mg/L (appendix B).

Sub surface Irrigation - installation on steep slopes

To prevent effluent pooling on the surface, a design irrigation rate of 15mm/wk is recommended. This corresponds to an infiltration rate of about 0.002m/d, approximately an order of magnitude lower than indicative infiltration rates associated with medium to heavy clays.

Sub-surface irrigation systems shall be designed and installed in accordance with AS1547:2000 appendix 4.5C. A minimum 200mm depth of sand is required for the installation of the sub-surface dripper lines. Pump systems and dripper irrigation systems must be specifically designed for each site. As the *review* recommends, subsurface irrigation is an appropriate method of on-site constraints allow (Whitehead and Associates, p7)

Where terracing is required (slopes $>$10%), care should be taken such that topsoil is reinstated beneath the distribution system and a minimum 400mm of soil exists beneath the disposal system. This will be feasible as bedrock was struck at approximately 1m depth throughout the site.

Updated design

An updated summary of design parameters is contained in Table 1, including specific requirements for steep sites. An updated lot layout and location of nominated disposal areas and nutrient absorption areas is contained in appendix A. Updated water balance and nutrient balance calculations that agree with the *review* are contained in appendix B.

Lot 4 may require a minimum 6.3m^3 of wet weather storage to prevent surface flows in winter months unless a mound system is designed for this site

Planting over the irrigation areas of the site shall be undertaken in accordance with the landscape masterplan and the vegetation guideline included in appendix 2 of the Eurobodalla Shire Council's On-Site Sewage Management Code of Practice, 2003.

Table 1: Summary of site characteristics and system sizing

Lot	Closest Bore Hole with recorded results	Soil Texture	Average Slope over nominated disposal area (%)	Nominated available disposal area (m^2)	Appropriate disposal system and design irrigation rate (mm/wk)	Required disposal area for zero wet weather storage (m^2)	Wet Weather storage (m^3)	Area available for nutrient assimilation (within property boundaries)	Sufficient area for nutrient assimilation	Comments	Specific design requirements
1	6	Weakly structured clay loam / Light Clay Bedrock @1.3m	16	947	Sub-surface irrigation (15)	719	0	1177	Y		Distribution – Pressure compensating drip emitters Pump – Pump must be sufficient to handle pressures required for a large disposal area Terracing – If necessary where slopes exceed 20%. Must reinstate topsoil beneath distribution pipes and maintain a minimum 400mm of soil beneath the distribution system.
2	6	Weakly structured clay loam / Light Clay Bedrock @1.3m	22	720	Sub-surface irrigation (15)	719	0	1133	Y		
3	4	Strongly structured heavy clay Bedrock not struck	17	783	Sub-surface irrigation (15)	719	0	1057	Y		
4	7	Strongly structured med clay Clay with high gravel content transitioning to fractured rock at 0.9m	10	532	Sub-surface irrigation (15) Mound (21)	719 280	6.3	982	Y	Available disposal area is constrained by buffers. Wet weather storage required to ensure no surface flow occurs in winter months Or use mound for disposal method	
5	8	Moderately structured medium clay Bedrock @1.3m	15	728	Sub-Surface irrigation (15) Mound (21)	719 280	0	1008	Y		
6	8	Moderately structured medium clay Bedrock @1.3m	18	727	Sub-Surface irrigation (15)	719	0	985	Y		
7	5	Moderately structured medium clay Bedrock @1.2m	20	829	Sub-Surface Irrigation (15)	719	0	1047	Y		
8	5	Moderately structured medium clay Bedrock @1.2m	14	805	Sub-Surface irrigation (15) Mound (21)	719 280	0	1316	Y		
9	1	Weakly structured medium clay Bedrock @1.3m	16	864	Sub-Surface irrigation (15)	719	0	>1500	Y		
10	1	Weakly structured medium clay Bedrock @1.3m	22	726	Sub-Surface irrigation (15)	719	0	>1500	Y		
11	1	Weakly structured medium clay Bedrock @1.3m	15	727	Sub-Surface Irrigation (15) Mound (21)	719 280	0	1337	Y		
12	2	Weakly structured medium clay Bedrock @1.3m	24	730	Sub-Surface Irrigation (15)	719	0	1104	Y		
13	3	Weakly structured medium clay Bedrock @0.7m	21	740	Sub-Surface Irrigation (15)	719	0	1119	Y		

Discussion

The updated layout demonstrates that the subdivision is feasible with on-site wastewater disposal. The maximum disposal area required is 719m^2 whilst the minimum lot size is 5000m^2, suggesting that even when buffers and building lots are accounted for significant area for disposal and nutrient adsorption remains, as shown in the updated lot layout.

It is agreed that some of the sites are constrained, particularly by slope and the associated design issues that this creates. We believe that many of these issues can be addressed at the detailed design stage and have outlined how these issues could be managed.

The *review* states "Overall, it is unlikely that the individual onsite treatment systems would directly cause adverse impacts to the Marine Park" when discussing the impact of appropriately selected, sized and maintained treatment systems. We would concur with this statement, and add; that the proposed subdivision needs to be viewed in the context of surrounding urban and rural residential development currently draining to the marine Park, as well as Council's STP discharge into the Marine Park when considering the potential impacts of this particular development.

Conclusion and Recommendations

To ensure appropriate effluent management for the proposed subdivision the following is recommended:

- For effluent treatment a secondary level AWTS treatment system or equivalent that can achieve an effluent quality of 30mg/L for total nitrogen and 12mg/L for total phosphorous.
- A minimum 719m^2 of sub-surface irrigation area is recommended for each lot within the area shown in appendix A, apart from lots 4, 5 and 8 which may be suitable for a mound disposal system which would require in the order of 300m^2.
- Detailed design of distribution systems and pump systems is necessary at the detailed design stage for individual development applications for each lot.
- Detailed design of disposal areas including terracing where necessary shall be undertaken at the detailed design stage for individual development applications.
- The *report* outlined the specific shape and size of irrigation areas. We now recommend that the configuration of disposal areas be determined during development applications for individual blocks.

Yours faithfully

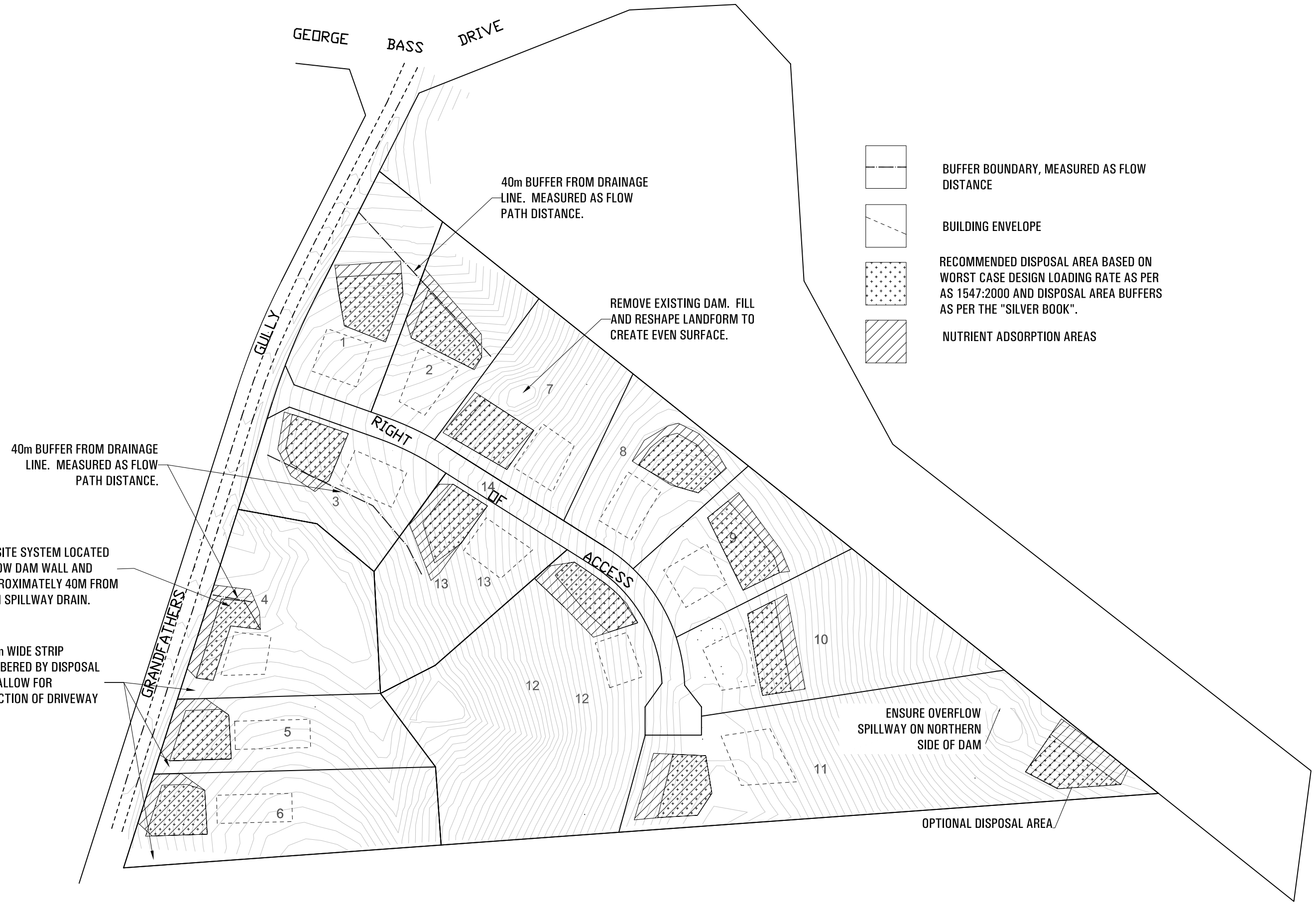
Lachlan Bain
Environmental Engineer / Environmental Manager
STORM_CONSULTING PTY LTD

REFERENCES

Whitehead and Associates, *Evaluation of On-site Wastewater management Scheme for 13 Lot Rural-residential Subdivision at Lot 2 DP 250984, 9 Grandfathers Gully Road,* 2008.

Australian Standards, *On-site domestic-wastewater management*, Standards Australia, 2000.

APPENDIX A – UPDATED LAYOUT



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ISSUE	REVISION	BY	CKD	DATE
A	FOR COMMENT	BA	LB	27/02/06
B	AMENDED BUILDING ENVELOPES	LB		31/3/08
C	UPDATED WATER BALANCE AND NUTRIENT DISPOSAL AREAS	LB	RW	05/11/08

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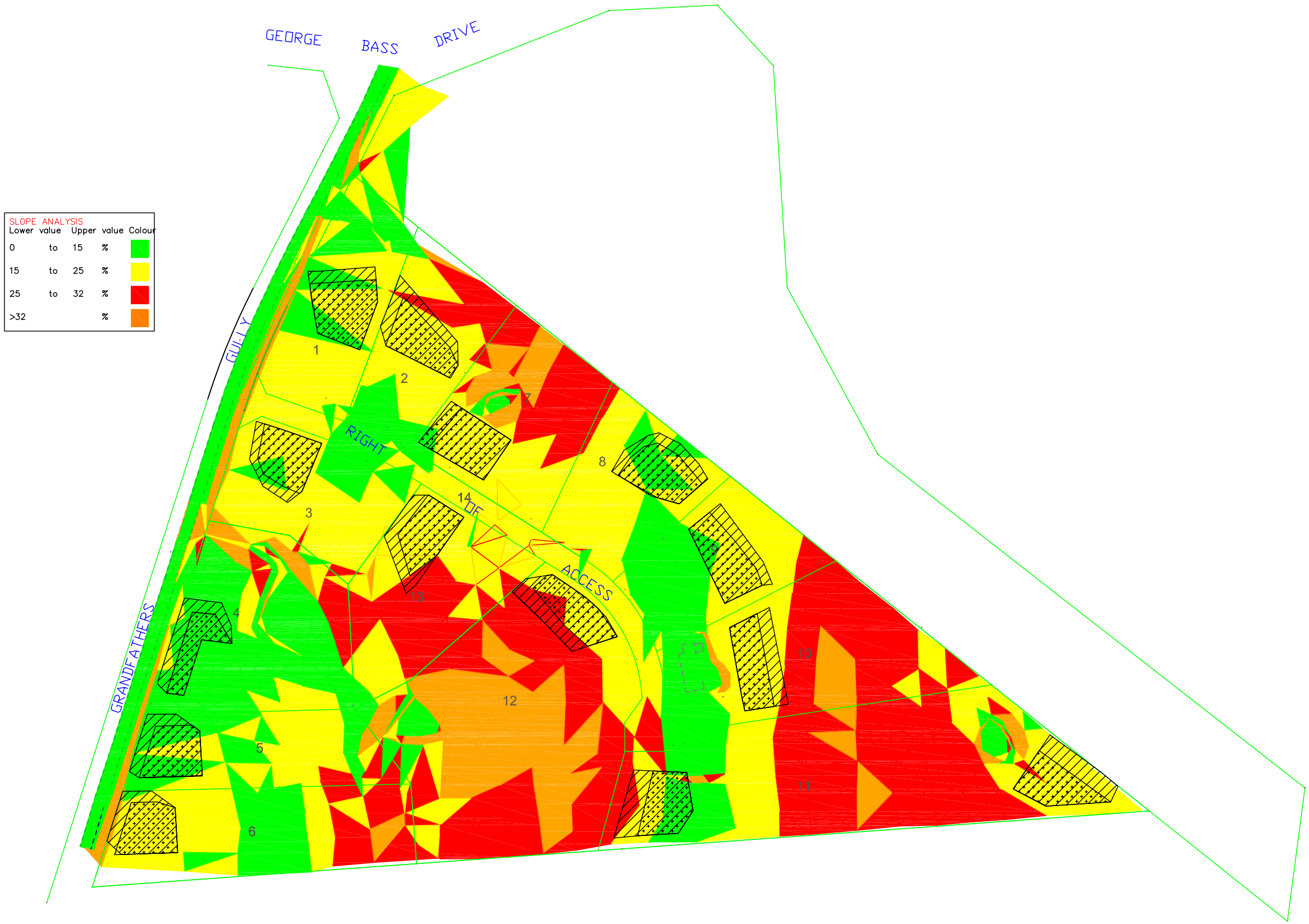
DRAWN: BA | DESIGNED: LB | CHECKED: LB

CLIENT: DAVID BREWER, 648 THE RIDGE ROAD, MALUA BAY NSW 2536

WCM FOR GRANDFATHERS GULLY
EFFLUENT DISPOSAL PLAN
AVAILABLE AREA

DRAWING: G491/PO1
SHEET: 1 OF 1 | A3



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CLIENT: DAVID BREWER
648 THE RIDGE ROAD
MALUA BAY NSW 2536

WCM FOR GRANDFATHERS GULLY
EFFLUENT DISPOSAL PLAN
SLOPE ASSESSMENT

DRAWING: G491/PO2
SHEET: 1 OF 1
A3

APPENDIX B – UPDATED WATER BALANCE MODELS

Water balance for Subsurface irrigation

MINIMUM AREA METHOD

Daily water use = **805 L/d** (see councils guidelines) if it has best rated toilets etc… can be reduced

Design percolation rate (Based on texture classification and AS1547)= **15 mm/wk** Weakly structured med clay

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Number of days	31	28	31	30	31	30	31	31	30	31	30	31	365
Precip	86.9	95.6	65.1	68.4	65.8	68.5	43.4	56.9	67.7	94.2	93.8	80.1	886.4
Evaporation	195	157	136	95	68	54	59	84	110	144	161	198	1461
C factor	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	9
OUT													
Evapotrans with crop factor	156	125.6	108.8	66.5	47.6	37.8	41.3	58.8	77	115.2	128.8	158.4	1121.8
Percolation	66.43	60.00	66.43	64.29	66.43	64.29	66.43	66.43	64.29	66.43	64.29	66.43	782.14
Output	222.43	185.60	175.23	130.79	114.03	102.09	107.73	125.23	141.29	181.63	193.09	224.83	1903.94
IN													
Precip	86.90	95.60	65.10	68.40	65.80	68.50	43.40	56.90	67.70	94.20	93.80	80.10	886.40
Possible Effluent irrig	135.53	90.00	110.13	62.39	48.23	33.59	64.33	68.33	73.59	87.43	99.29	144.73	1017.54
Actual eff irrig	34.71	31.35	34.71	33.59	34.71	33.59	34.71	34.71	33.59	34.71	33.59	34.71	408.66
Input	121.61	126.95	99.81	101.99	100.51	102.09	78.11	91.61	101.29	128.91	127.39	114.81	1295.06
Storage	-100.82	-58.65	-75.42	-28.80	-13.52	0.00	-29.62	-33.62	-40.00	-52.72	-65.70	-110.02	
Cumulative	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

Irrigation area (m2) = **719**

Storage (m3) = **0.001871**

Water balance for Mound

	MOUND DESIGN	Source		Amount	Units	Comments
1	Design Flow	Appendix 4.2D + ESC		805.00	L/d	7 people @ 145L each (4 Bedrooms, Standard water reduction fixtures)
2	Basal loading rate	Table 4.2A3 of AS1547:2000		3.00	L/sq.m/day	Class 5 soil (G Metzler Report)
3	Sand loading rate	Cl 4.2A9.2.2 of AS1547:2000		50.00	L/sq.m/day	
4	Linear loading rate	Cl 4.2A9.2.2 of AS1547:2000		50.00	L/m/day	Allowance for vertical drainage
5	Gravel Absorption Area width A	A = 4 / 3		1.00	m	
6	Gravel Absorption Area length B	B = 1 / 4 = 1 / (3 / 5)		16.10	m	
7	Min. Basal Width	"= 4 / 2"		16.67	m	Min. width at sand / soil interface
	Base Area Min			268.33		
	Width overall at sand - gravel interface			1.60	m	Width A + 0.3m upslope & 0.3m downslope
	Minimum Fill Depth	depth of sand under gravel D		0.35	m	
		depth of sand under gravel E		0.47	m	Calculated for grade
	Gravel layer thickness	F		0.20	m	
	Average Sand height			0.61	m	To calculate mound widths
	Soil Layer thickness	G		0.30	m	
	Soil Cap total thickness	H		0.45	m	
	Mound height (max)	E+F+H		1.12	m	Approx. max. height to soil surface
	Absorption area (min.)	"1/3"		16.10	sq.m	Check for minimum area at sand -gravel interface - OK
8	Basal area (min.)	Check = 1 / 2		268.33	sq.m	Minimum - to check below
	Batter face downslope		1 in	3.50		Flatter downslope to protect toe
	Batter face upslope		1 in	3.00		
	End batters		1 in	3.00		
	Check Downslope Width J	see diagram		3.68	m	
	& Upslope Width I			1.35	m	
	& End Batter Width K			1.83	m	
					1.63392857	
	Sand Mound Base Dimensions:					
	Sand base width	Sideslopes + absorption width A		14.00	m	If greater than "Min. basal width" OK
	Sand base length	Endslopes + absorption length B		19.76	m	
	Sand base area			276.64	sq.m	If greater than "Basal Area Min." OK
	Overall Mound Base Dimensions:					
	Total width	Sideslopes + absorption width A		14.60	m	
	Total length	Endslopes + absorption length B		20.36	m	
	Total area			297.26	sq.m	
	Sand volume			90.66	cu.m	
				149.59	tonnes	Assuming 1.65 tonnes / cu.m for sand
	Site slope			0.12		

Nutrient balance calculations

	BH1	BH4	BH5	BH6	BH7
Hydraulic Load Rate L/d	**805**	**805**	**805**	**805**	**805**
Concentration of P after treatment (mg/L)	**12**	**12**	**12**	**12**	**12**
Concentration of N after treatment (mg/L)	**30**	**30**	**30**	**30**	**30**
Bulk Density (kg/m3)	**1500**	**1500**	**1500**	**1500**	**1500**
Psorp (mg/kg)	**474**	**660**	**529**	**394**	**674**
P Sorption (kg/ha)	7110	9900	7935	5910	10110
Available P Sorption (kg/m2)	0.24	0.33	0.26	0.20	0.34
Critical P loading Rate (mg/m2/d)	2.80	2.80	2.80	2.80	2.80
Veg uptake of P over 50 years (kg/m2)	0.05	0.05	0.05	0.05	0.05
P generated in 50 years (kg)	176.30	176.30	176.30	176.30	176.30
Irrigation area required to contain phosphorous (m2)	611.92	462.60	558.60	710.58	454.25
Critical N loading rate (mg/m2/d)	25	25	25	25	25
Irrigation area required to contain Nitrogen (m2)	966	966	966	966	966