Attachment 9

to

item 002

Report on Effluent Management System dated April 2019

date of meeting: 18 February 2020
location: council chambers
time: 6:30 p.m.

Hawkesbury City Council

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REPORT ON

INVESTIGATION AND ASSESSMENT FOR THE SITING OF A PROPOSED EFFLUENT MANAGEMENT SYSTEM AT LOT 121 DP 1067098, No. 144 MOUNTAIN VIEW CLOSE, KURRAJONG HILLS

PREPARED FOR: MR. P. FINLEY
SUBMITTED TO: HAWKESBURY CITY COUNCIL

APRIL 2019

CONTENTS

1. INTRODUCTION

This report outlines the results of an investigation and assessment for on-site effluent management at Lot 121 DP 1067098, No. 144 Mountain View Close, Kurrajong Hills. The investigation was performed at the request of Mr. Finley. The report will be submitted to Hawkesbury City Council.

The property comprises a vacant parcel of land with an area of 4.175 hectares. As shown in the accompanying plan, Figure 1, the proposed development comprises the construction of a dwelling and the siting of an effluent management system.

2. PROPOSED EFFLUENT MANAGEMENT SYSTEM AND DESIGN WASTEWATER VOLUME

As confirmed with Mr. Finley, the proposed effluent management scheme for the dwelling comprises the A & A Worm Farm Waste System **(A & A WFWS)**. It is understood that the system comprises a single polymer tank with an operating capacity of 3000 litres, which can process up to 1800 litres of wastewater/day. The nominated location of the proposed A & A WFWS as determined with Mr. Finley off the southeastern corner of the dwelling, pending exact final confirmation, is shown in Figure 1.

Manufacturers specifications, NSW Health Accreditation and any other relevant details in relation to the proposed A & A WFWS will be provided by the supplier for submission to Council in addition to this report.

Options for the land application of treated effluent from the A & A WFWS typically include absorption trenching and irrigation by subsoil dispersal. Note that surface irrigation is not permitted due to the lack of formal disinfection.

For the dwelling, it is proposed to apply treated effluent to the land with use of subsoil dispersal which normally covers a much larger area compared with that required for trenching. Absorption trenching is not proposed due to the clay subsoil as outlined in Section 6, which results in an unrealistically large length requirement and issues with soil drainage. Note that subsoil dispersal is also known as low pressure effluent distribution, **(LPED)** as noted in AS/NZS 1547 (2012). Due to the lack of formal disinfection with the proposed A & A WFWS, it is understood that the subsoil dispersal lines will be placed at a depth of 300mm, as any less than this is not permitted by the NSW Health Department.

This report is submitted to Council as part of the approval process for the proposed dwelling and on-site effluent management system. Blue Mountains Geological and Environmental Services is not responsible or liable for the installation, operation, maintenance and on-going performance of both the A & A WFWS and area utilised for the land application of the treated effluent. An appropriately qualified and experienced person or persons should install the A & A WFWS tanks and subsoil dispersal lines for land application.

The A & A WFWS treats all domestic grey and black water effluent, as well as household solid waste. Solids are separated from liquids by a filter which is set horizontally above the bottom of the chamber. Liquids flow through the compost and filter leaving soaps, detergents and organic material on and in the compost while the liquid remains aerated and flows to a closed trench system or subsoil dispersal area (latter proposed at the subject site). Aeration is provided through a wind driven ventilator which draws air through the plumbing vent system, through the pile and exhales via the whirly vent. Where the land fall allows, the treated wastewater is drawn off by gravity, or alternately it is pumped using a small sump pump from the A & A WFWS to the land for application.

Typical treatment levels for domestic wastewater from the A & A WFWS are provided below:

- BOD_5 = average 20mg/L.
- Suspended Solids = average 20mg/L.
- Total Nitrogen (N) = average 25 - 27mg/L.
- Total Phosphorus (P) = average 8.1mg/L.
- Faecal coliforms = average 2.0×10^4 cfu/100mL

It is understood that the treated effluent from the A & A WFWS comprises a clear aerated liquid which contains worm castings and eggs and is applied to the land via 'pulse dosing' at a rate of up to 80 - 100 litres/minute (i.e. when gravity feed is not possible and pump is used). A high effluent quality and level of treatment is conferred by reference to Table 11 in Department of Local Government et. al. (1998) which shows the expected quality of primary treated wastewater after treatment in a septic tank – i.e. treatment levels for the A & A WFWS are significantly better than that for septic tanks. Furthermore, reference to Table 14 from Department of Local Government et. al. (1998) shows that, with the exception of faecal coliform levels for formally disinfected effluent, the treatment levels achieved by the A & A WFWS conform with or are better than that achieved with secondary treated effluent from an aerated wastewater treatment system. It is with consideration to faecal coliforms and public health that a below-ground arrangement is proposed for land application via the use of subsoil dispersal, whereby treated effluent will not be applied directly onto the land surface.

Further to the details above and with reference to Table 14 in Department of Local Government et. al. (1998), the wastewater from the A & A WFWS is considered to best equate with what can be termed as 'undisinfected secondary treated effluent'. Nevertheless, experience indicates that Local Government conforms with the approach of the NSW Health Department and deem the wastewater derived from the A & A WFWS as being only primary treated effluent based solely on the lack of formal disinfection (albeit having an overall much better quality).

It would be prudent, as with on-site or reticulated sewer, to implement a water usage minimisation scheme in the proposed dwelling to extend the effective life span and performance of the effluent management system as a whole. Whilst the A & A WFWS provides for re-use of all effluent generated by application to the land, reducing the loads to be treated and discharged will significantly decrease the potential for adverse environmental impacts. Consideration should therefore be given to the installation of a set of ideally five star rated water limiting devices/appliances such as low-flow showerheads (e.g. 9 litre/minute), low litreage dual flush toilets (e.g. 3/6 litre variety), aerator taps and what will be a front loading washing machine that are required as part of the BASIX scheme in Local Government.

It is suggested to utilise 'environmentally friendly' cleaning, washing and detergent products in the dwelling to reduce the levels of P, as well as sodium, discharged to the A & W WFWS and subsoil irrigation area. Furthermore, reducing the amounts of such products used would also be beneficial to the environment. Reference to the Figure in Appendix 1 shows the sodium contents in grams/wash for a variety of laundry detergents used in both front and top-loading washing machines (from Dr. R. Patterson, Lanfax Labs). It is recommended to utilise laundry detergents with the lowest sodium content as practical. Cross-matching low sodium products with low P ones would also be beneficial.

In addition to the details above, it is important to ensure that chemical cleaning and detergent products are compatible for use with an on-site effluent treatment system. Such products can kill off bacteria in a treatment device, which results in ineffective treatment (particularly with respect to faecal coliforms). Use of harsh bleaches and disinfectants should be avoided, but only used sparingly if necessary. Alkalinity and P contents in cleaning products can also have an influence on performance and the treatment levels achieved. However, with low P products, a relatively higher alkalinity is required in order to get an appropriate level of cleaning, which can adversely impact upon a treatment system.

Further to discussions with Mr. Finley, the following details are provided in relation to wastewater generation:

- The proposed dwelling will be serviced with a tank water supply derived from roof runoff.
- The proposed dwelling comprises four bedrooms.
- The proposed dwelling will be occupied by five persons on a full-time basis (i.e. the Finley family).

As distinct to the lesser number of occupants, design effluent volume and subsoil dispersal area calculations are based on the maximum potential occupancy level of the proposed dwelling, which is dependent on the number of bedrooms. Reference to Table J1 in AS/NZS 1547 (2012) shows that a four bedroom dwelling has a population equivalent of 6 - 7 persons. For use in this assessment, the maximum potential occupancy level of the proposed dwelling is set at six persons. This represents an ample allowance for two persons/bedroom in two of the bedrooms and one person/bedroom in the remaining two bedrooms.

Reference to Table H1 in AS/NZS 1547 (2012) shows that the typical wastewater design flow from dwellings with tank water supplies derived from roof runoff is 120 litres/person/day.
Based on the details above, the maximum design effluent volume from the proposed dwelling applied to subsoil dispersal area calculations is:

* 6 persons x 120 litres/person/day = 720 litres/day.

It is important to ensure that appropriate water-conservation practices are carried out in the dwelling so the maximum design effluent volume above is not exceeded – i.e. ideally kept as low as possible. However, for the five persons who will initially reside in the dwelling, the design output of effluent is 600 litres/day, or 83.3% of the maximum.

3. SITE DESCRIPTION

The property comprises an irregular-shaped parcel of land that is situated off the eastern end of Mountain View Close. As shown in Figure 1, the proposed dwelling is positioned in the gently sloping northernmost part of the property in relatively close proximity to the frontage with Mountain View Close.

The proposed land application area (LAA) for treated wastewater, i.e. where the subsoil dispersal lines will be established, is also located in the northern part of the property with set-back distances of 60m east-southeast of the dwelling and 5m from the nearest northern boundary, which is in an upslope position. This area has a typical grade of 1 in 6 - 8 in a southeast to east-southeasterly direction based on the contours at 0.5m intervals on the survey plan. Whilst falling in this direction, the LAA on a convex upper slope is well-elevated and affords exposure to the northerly aspect and prevailing winds. The vegetation across the LAA and adjacent parts comprises a well-developed pasture grass cover.

The proposed LAA is positioned at a typical elevation of 134 - 137.5m. Observations during the site investigation and reference to Figure 1 shows that the nearest defined 'water feature' in the relevant flow path of the LAA is Little Wheeny Creek with a perennial, which conforms with the position of the majority of the southern to eastern property boundary. This watercourse is located at a minimum approximately 127m in the relevant land fall direction to the southeast from the closest point of the LAA. Note that this distance in plan view is considerably increased along the actual ground surface to at least 150m or more.

Further to the details above, there is a dam adjacent to the western boundary that is at a minimum direct distance of about 27m in plan view to the southwest from the closest southwestern corner of the proposed LAA. This distance is considerably increased along the ground surface to approximately 35 - 40m. There is also a poorly-defined drainage line/depression in the terrain off the upslope northern side that feeds the dam, along with general sheet flow runoff from the concave slope above it (Figure 1). However, there is no defined drainage line/depression off the downslope southern side of the dam. Note that the dam proper, drainage line above it and general sheet flow runoff path to the south extending from the southwestern corner of the dam where the overflow point is situated are not within the land fall direction of the terrain comprising the subsoil dispersal area, whereby a prescribed set-back distance is therefore irrelevant. This means that the area comprising the proposed LAA does not feed the dam, drainage line above it or general sheet flow path off the downslope southern side of the dam.

Climatic conditions at the site are generally temperate throughout the year, however hot to very hot summer weather and cold winter weather is also experienced. Reference to the Kurrajong 1:25,00 scale topographic map shows that the average annual rainfall in the area is in the order of 794mm and the average daily maximum temperature ranges from 17 - 18^{0}C in winter to 27 - 28^{0}C in summer. Rainfall and evaporation data is also provided in Table 1, Section 7.2.

4. SITE ASSESSMENT METHODOLOGY

The initial phase of the fieldwork comprised a site inspection and ground survey on 27/3/19 aimed at delineating the preferred position of the proposed LAA with respect to the location of the proposed dwelling and the geomorphological characteristics of the land.

Further to the ground survey, three 100mm diameter hand-auger holes were bored to a maximum depth of 1.2m across the proposed LAA. The auger holes were used to determine the physical characteristics of the subsurface strata and provide a representative description of this.

To assess soil permeability, results from the auger holes are related to the textural/structural classification in Table E1 of AS/NZS 1547 (2012) which enables determination of the soil category and corresponding indicative permeability value. An indicative permeability value can be converted to a design irrigation rate **(DIR)** from Table M1 in AS/NZS (2012).

5. GROUND SURVEY AND PHYSICAL CONSTRAINTS

The location of the proposed LAA for subsoil dispersal has been carefully delineated on the site with Mr. Finley (Figure 1). Results from the ground survey indicate that the property is substantially affected by the following physical constraints to the land application of treated effluent:

- The dam off the southern alignment of the dwelling and associated buffer zone.
- The poorly-defined drainage line/depression between the dam and the dwelling, including the associated buffer zone.
- The occurrence of areas with steep terrain.
- The position of Little Wheeny Creek with a perennial flow and the associated buffer zone.

The physical constraints considerably limit the terrain available for effluent disposal which has led to the siting of the proposed subsoil dispersal area on the most gently sloping land possible at the location shown in Figure 1.

Reference to Table of the guidelines in Department of Local Government et. al. (1998) shows that minimum recommended buffer distances of 40m from dams and intermittent watercourses and 100m from perennial watercourses are required for any form of effluent land application. It is important to acknowledge that these buffer distances are in the actual land fall direction and not in a direct line against the hydraulic gradient. So whilst the proposed LAA is approximately 27m in plan view from the closest point of the dam, it has been careful positioned to ensure it is not on terrain that falls to and feeds the dam (or poorly-defined drainage line/depression above it). In this instance a prescribed set-back distance is irrelevant. Therefore, as detailed in Section

3, the nearest water feature in the flow path of the LAA is Little Wheeny Creek with a perennial at an appropriate minimum distance of approximately 127m in the relevant land fall direction to the southeast.

The proposed LAA also maintains appropriate buffers that exceed the minimum set-back distances from the proposed dwelling and all property boundaries. These minimum distances are 3m and 6m from dwellings and boundaries when a LAA is downslope and upslope of these features respectively.

The site of the proposed LAA affords exposure to the northerly aspect and prevailing winds, which in conjunction with the grass cover to be managed (see Section 7.3), will enhance the benefits of evapotranspiration and reduce the absorption loads of treated wastewater on the subsurface strata.

6. SUBSURFACE PROFILE

Observations on the site and reference to the Penrith 1:100 000 scale Soil Landscape map indicates that the proposed LAA is underlain by the residual 'Lucas Heights' group which occurs on gently undulating crests and ridges on plateau surfaces of the Mittagong Formation (alternating bands of shale and fine grained sandstone). This occurs in close proximity to the contact with the Kurrajong soil group, which is underlain by Wianamatta Group shales.

The soils of the Lucas Heights group comprise moderately deep (50 - 150cm), hardsetting Yellow Podzolic Soils and Yellow Soloths (Bannerman & Hazelton, 1990). General limitations of the Lucas Heights group include stony soil, low soil fertility, low available water-holding capacity, strong acidity (localised), sodicity (localised) and high potential aluminium toxicity (localised) (Bannerman & Hazelton, 1990).

The subsurface profile observed in the auger holes has a 'gradational' structure, as there is a poorly-defined textural and permeability contrast between the different soil horizons. With reference to Table E4 in AS/NZS 1547 (2012), it is considered that all soil horizons have a moderate structure.

The soils are described in accordance with the classification schemes in Australian Soil and Land Survey: Field Handbook (1990) and AS/NZS 1547, 2012 (Appendix 1). The typical subsurface profile observed in the auger holes across the proposed LAA is detailed below.

(i) LOAM (TOPSOIL) – A1 Horizon

- observed from the surface to a depth ranging from 0.2 - 0.25m.
- comprises dark-brown to dark grey-brown, fine grained loam with few ironstone fragments (i.e. 2 - 10% coarse fragments from Table E2 in AS/NZS 1547, 2012).
- soil category 3 for loams from Table E1 in AS/NZS 1547 (2012).

(ii) CLAY LOAM – A2 Horizon

- observed from 0.2 - 0.25m to an average depth of 0.6m.
- comprises light-brown to brown, fine grained clay loam with few ironstone fragments (i.e. 2 - 10% coarse fragments). Below 0.4m, the content of coarse fragments increases to the 10 - 20% range (i.e. common).
- soil category 4 for clay loams.

(iii) LIGHT CLAY – B Horizon

- observed from an average 0.6m to a maximum depth of 1.2m.
- comprises firm to stiff, light-brown light clay with common ironstone fragments (i.e. 10 - 20% coarse fragments).
- soil category 5 for light clays.

No free groundwater was observed in the auger holes to 1.2m depth. The exact depth to a consistent groundwater table below the site of the proposed LAA is not known. However, the expected minimum depth to a consistent groundwater would be in the vicinity of at least about 30m or more.

7. SIZING OF THE PROPOSED LAND APPLICATION AREA

Both hydraulic and water balances are carried out to assess the size of the area required for subsoil dispersal for the highly treated effluent to be derived from the proposed dwelling. LAA sizing calculations are outlined in the following sections.

7.1 Hydraulic Balance

Results from the auger holes in Section 6 and reference to Table M1 in AS 1547 (2012) correspond with soil category 5 for light clays based on the 'most-limiting' light clay subsoil in the B horizon. This corresponds with an indicative permeability value of 0.06 - 0.12m/day for a moderate structure. The indicative permeability value can be converted to a DIR.

Reference to Table M1 in AS/NZS 1547 (2012) shows that for soil category 5 and subsoil dispersal (or LPED irrigation) as proposed, the corresponding DIR is 2.5mm/day. This value equates with a wastewater application rate of 2.5 litres/m^2/day. Based on this value, the area required for subsoil dispersal from the proposed dwelling is:

* 720L/day divided by 2.5L/m^2/day = 288m^2.

The area of 288m^2 will be compared with that required on the basis of the water balance methodology.

7.2 Water Balance

Irrigation area calculations in this Section are based on the water balance methodology. Table 1 is the water balance for the site at Kurrajong Hills based on nil runoff and 20mm/month percolation (i.e. lowest monthly value in Department of Local Government et. al., 1998). As with assessments in Hawkesbury City Council, rainfall and pan evaporation data in Table 1 is sourced from the Bureau of Meteorology records for the UWS Hawkesbury Campus at Richmond.

In Section 6.6.1 of the EPA (1995) document there is an equation that is used to determine the 'field area' required for irrigation systems based on the liquid loading rate:

$$A = \frac{36.5 \times Q}{H}$$, where

A = field area in hectares.

Q = wastewater flow in kL/day – maximum 0.72kL/day from the proposed dwelling.

H = annual liquid loading in millimetres/year – 748.3mm from Table 1.

Note that an equivalent equation is also detailed in the guidelines from Department of Local Government et. al. (1998).

TABLE 1: WATER BALANCE TABLE FOR THE SITE AT KURRAJONG HILLS BASED ON NIL RUNOFF AND 20mm/MONTH PERCOLATION

MONTH	RAINFALL (mm)	EVAPORATION (mm)	CROP FACTOR	EVAPOTRANSPIRATION (mm)	PERCOLATION (mm/month)	EFFLUENT APPLIED (mm)
JAN	71.4	186	0.9	167.4	20	116
FEB	74.3	140	0.9	126	20	71.7
MAR	64.6	127.1	0.8	101.6	20	57
APR	51	93	0.75	69.7	20	38.7
MAY	30.8	68.2	0.7	47.7	20	36.9
JUN	38.1	51	0.6	30.6	20	12.5
JUL	29	58.9	0.6	35.3	20	26.3
AUG	24.2	83.7	0.6	50.2	20	46
SEP	34	114	0.7	79.8	20	65.8
OCT	43.4	142.6	0.75	106.9	20	83.5
NOV	66.3	147	0.8	117.6	20	71.3
DEC	56.4	176.7	0.9	159	20	122.6
TOTAL	583.5	1388.2		1091.8		H=748.3

- Crop factor variable and based on seasonal differences.

The field area equation is applied to the proposed dwelling:

$$A = \frac{36.5 \times 0.72\text{kL/day}}{748.3\text{mm}}$$

$$= 0.0351 \text{ hectares}$$

$$= 351\text{m}^2$$

Rounded up $= 355\text{m}^2$.

The equation indicates that an area of 355m^2 is required for subsoil dispersal irrigation to cater for the maximum potential occupancy of the proposed dwelling.

Summary

Based on the details in Sections 7.1 and 7.2 for the maximum design effluent volume of 720 litres/day from the proposed dwelling, the areas calculated for land application by subsoil irrigation as proposed are:

1. Hydraulic balance = 288m^2.
2. Water balance = 355m^2.

Based on the largest of the areas above, i.e. the water balance, an area of 355m^2 is required for subsoil dispersal at the subject site. Therefore,

* PROPOSED LAA = 355m^2 for the maximum design effluent volume of 720 litres/day from the proposed dwelling.

As shown in Figure 1, the proposed LAA measures 25m x 14.2m in width.

Based on an area of 355m^2 for the maximum design effluent volume of 720 litres/day, the equivalent application rate is 2.029 litres/m^2/day – i.e. basically same for medium to heavy clays in soil category 6 and less than the hydraulic properties of the most-limiting light clay in the B horizon.

7.3 Preparation and Management of the Land Application Area

Appropriate preparation and management are important factors that significantly affect the ability of a LAA to contain and assimilate treated wastewater. It is important to ensure that the subsoil dispersal system utilised fully covers the area of $355m^2$ so the hydraulic and nutrient loads can be adequately catered for by the soils and vegetation cover.

Reference to Gardner et. al. (1997) indicates that loading rate should be balanced by allowable sinks. Allowable sinks for N are denitrification/volatilisation (typically 15 - 20% loss) and plant uptake, which depends on the plant yield and N concentration in the vegetation. Provided the vegetation in an effluent irrigation area is harvested and removed on a regular basis (years for trees, months for grasses/pasture), it will provide a sustainable and recurrent sink for N.

Allowable sinks for P are plant uptake (generally 8 - 10 times less than N uptake) and the storage capacity of the soil (may account for up to 30% of the N loading). Reference to Gardner et. al., (1997) indicates that for sandy soils, the P front moves downwards at a rate of about 20 years/metre of soil depth for a P concentration of about 10mg/litre of effluent. The many adsorption sites for P in soils and aquifers suggest that adverse groundwater consequences of P leaching are likely to be the exception rather than the rule.

As outlined for the Lucas Heights group in Section 6, to address the localised strong acidity, sodicity and high potential aluminium toxicity, as well as address the sodium content in the treated effluent and potential for dispersion, it is suggested to apply agricultural lime and gypsum across the LAA and immediately adjacent parts and incorporate into the top 50 - 100mm of soil. This will also assist to balance the soil chemistry, enhance soil structure, maintain soil drainage and fertility, and reduce the potential long-term adverse impacts that may arise from the discharge of treated effluent. It is understood that liquefied forms of lime and gypsum can also be considered.

Lime and gypsum can be purchased from selected plant nurseries and landscape/rural supply stores. Lime and gypsum can be applied at suggested rates of approximately 0.3 - $0.4kg/m^2$ (i.e. 3 - $4kg/m^3$) and 0.1 - $0.2kg/m^2$ (i.e. 1 - $2kg/m^3$) respectively in and adjacent to the LAA. The soil additives can also be re-applied and lightly incorporated into the top 50 - 100mm of soil as required every three to five years for example. Note that it would be prudent to contact the NSW Agriculture Department to assess any advice they can provide regarding types of soil additives, application methods and rates.

With the A & A WFWS, worms will be transferred from the treatment tank to the proposed subsoil dispersal area. This will further improve the drainage characteristics, general condition of the soils and overall ability to accept treated wastewater (particularly in the medium to longer term periods).

It is considered that the existing grass is appropriate in its current form for the land application of treated effluent. However, due to the disturbance by placement of the network of subsoil dispersal lines, it is recommended to intersow by seeding with a blend such as fescue, perennial rye, kikuyu, buffalo and kentucky blue for example (or similar).

Note that once the LAA is established, it is important to ensure that the grass is properly managed by being mown regularly to promote vigorous growth with the cuttings harvested and removed to avoid recycling nutrients back into the soils. In addition, grass must not be cut to a level that is too low as this will limit the depth and density of root growth.

Ensure that any upslope runoff is maintained away from the proposed LAA so that it only has to ideally cater for the treated wastewater and direct rainfall. This can be achieved with use of a contour bank or dish drain in the area above the subsoil dispersal area. However, with the convex upper slope position having minimal vegetated localised sub-catchment above the LAA, it is considered that upslope drainage control device are not imperative in the first instance and could be implemented if ever required in the future.

Stormwater provisions associated with the dwelling and tank water supply must not be directed towards the subsoil dispersal area and impede its proper functioning. Furthermore, clean watering of grass in and adjacent to the LAA must not be carried out.

In the event of weed proliferation due to the discharge of treated effluent, it is suggested that adequate eradication measures are implemented to prevent their possible spread beyond the margins of the LAA.

It is imperative to ensure that construction works do not adversely impact on the area delineated for the land application of treated effluent, such as the compaction and/or stripping of topsoil, unnecessary vehicular movements and the placement of building materials for example – i.e. maintain existing depth and condition of soil coverage and can partition the LAA prior to construction. However, it is considered unlikely that construction works would adversely impact due to the considerable distance between the proposed dwelling and LAA.

Once the LAA is established, it is important to ensure that there are no vehicular movements or provision of hoofed animals as this will have a detrimental impact on soil drainage and , structure, as well as potentially adversely impacting on the integrity of the subsoil dispersal lines – i.e. should be fenced-off if required.

8. CONCLUSION

(i) An investigation and assessment has been undertaken for on-site effluent management at Lot 121 DP 1067098, No. 144 Mountain View Close, Kurrajong Hills. The property comprises a vacant parcel of land with an area of 4.175 hectares.

(ii) The proposed development comprises the construction of a four bedroom dwelling and the siting of an effluent management system.

(iii) The proposed effluent management scheme for the dwelling comprises the A & A WFWS with subsoil dispersal for land application.

(iv) The design effluent volume applied to the sizing of the subsoil dispersal area with allowance for a tank water supply and maximum of six full-time occupants in the proposed dwelling is 720 litres/day.

(v) The proposed LAA for treated wastewater where the subsoil dispersal lines will be established is situated 60m east-southeast of the dwelling. This area also maintains appropriate buffers from all property boundaries and the nearest water features in the land fall direction.

(vi) Based on calculations in this report and the maximum design effluent volume, an area of 355m^2 is proposed for subsoil dispersal from the dwelling. Guidelines in relation to the preparation and management of the proposed LAA should also be followed, whilst the proposed A & A WFWS should be properly operated, serviced and maintained into the future.

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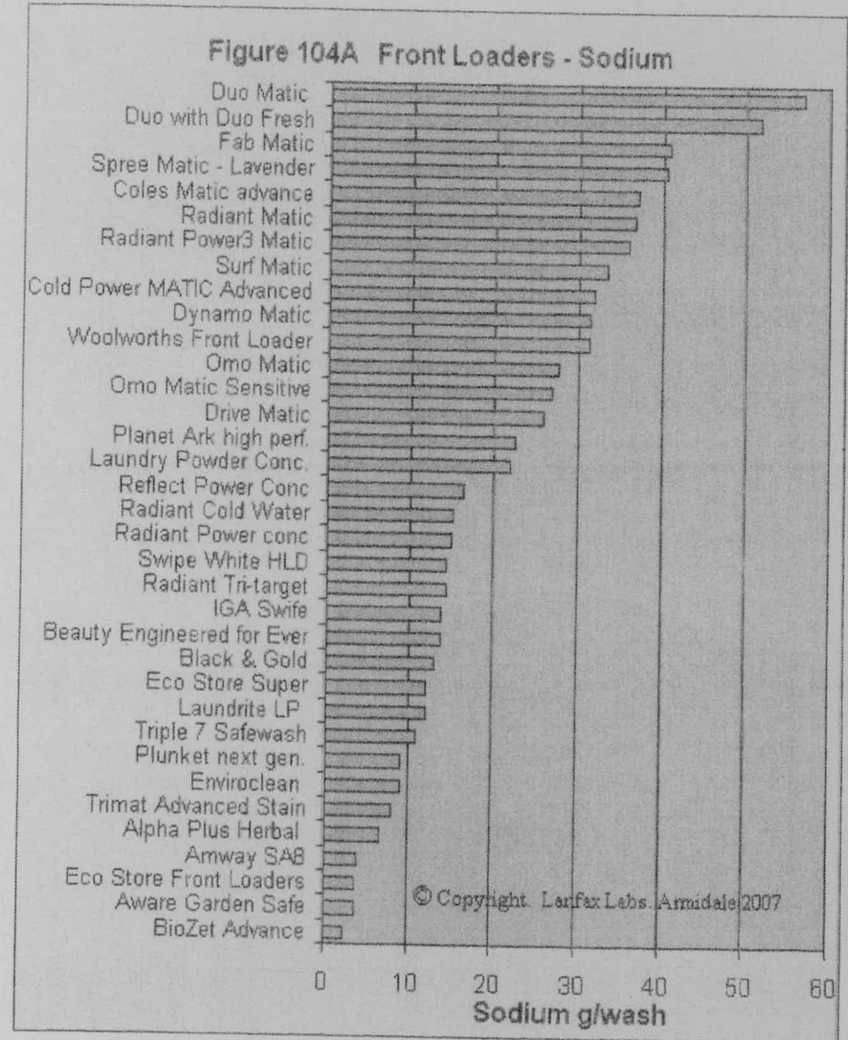
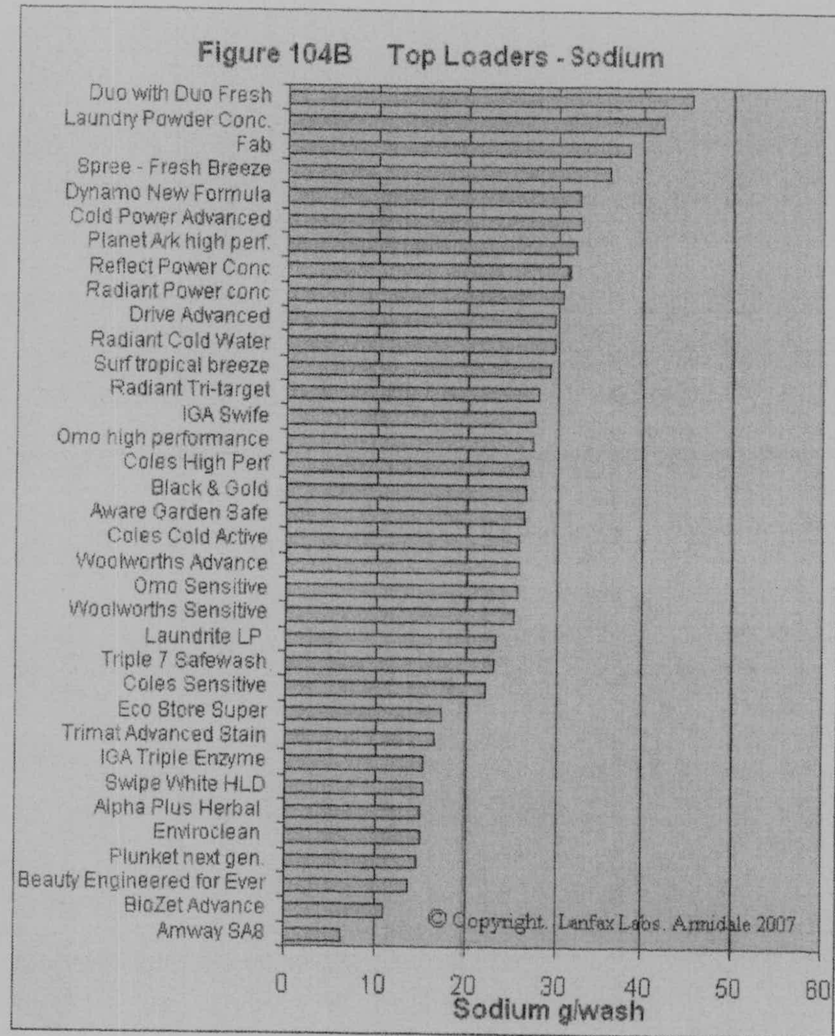
APPENDIX 1

SODIUM CONTENTS FOR A VARIETY OF LAUNDRY DETERGENTS AND SOIL CLASSIFICATIONS





Dr Robert Patterson. Lanfax Labs, Armidale NSW. Laundry Products Research **49 Laundry Detergents Powders (updated 24th November 2007) www. lanfaxlabs.com.au Accessed 9/5/08.**

TABLE E1
ASSESSMENT OF SOIL TEXTURES

Soil category	Classification	Properties	Typical clay content% (see Note)
1	Sand	Very little to no coherence; cannot be moulded; single grains stick to fingers	Less than 5
2	Loamy sand	Slight coherence; forms a fragile cast that just bears handling; gives a very short (5 mm) ribbon that breaks easily: discolours the fingers	5 – 10
	Sandy loam	Forms a cast but will not roll into a coherent ball; individual sand grains can be seen and felt; gives a ribbon 15 – 25 mm long	10 – 20
3	Fine sandy loam	As for sandy loams, except that individual sand grains are not visible, although they can be heard and felt; gives a ribbon 15 – 25 mm long	10 – 20
	Loam	As for sandy loams but cast feels spongy, with no obvious sandiness or silkiness; may feel greasy if much organic matter is present; forms a thick ribbon about 25 mm long	10 – 25
	Silty loam	As for loams but not spongy; very smooth and silky; will form a very thin ribbon 25 mm long and dries out rapidly	10 – 25
4	Sandy clay loam	Can be rolled into a ball in which sand grains can be felt; forms a ribbon 25 – 40 mm long	20 – 30
	Fine sandy clay	As for sandy clay loam, except that individual sand grains loam are not visible although they can be heard and felt; forms a ribbon 40 – 50 mm long	20 – 30
	Clay loam	Can be rolled into a ball with a rather spongy feel; slightly plastic; smooth to manipulate; will form a ribbon 40 – 50 mm long	25 – 35
	Silty clay loam	As for clay loams but not spongy; very smooth and silky; will form a ribbon about 40 – 50 mm long; dries out rapidly	25 – 35
5	Sandy clay	Forms a plastic ball in which sand grains can be seen, felt or heard; forms a ribbon 50 – 75 mm long	35 – 45
	Light clay	Smooth plastic ball that can be rolled into a rod; slight resistance to shearing between thumb and forefinger; forms a ribbon 50 – 75 mm long	35 – 40
	Silty clay	As for light clay but very smooth and silky; will form a ribbon about 50 – 75 mm long but very fragmentary; dries out rapidly	40 – 50
6	Medium clay	Smooth plastic ball, handles like plasticine and can be moulded into rods without fracture; some resistance to ribboning, forms a ribbon 75 mm or more long	40 – 55
	Heavy clay	Smooth plastic ball that handles like stiff plasticine; can be moulded into rods without fracture; firm resistance to ribboning; forms a ribbon 75 mm or more in length	50 or more

NOTE: The typical clay content figures are included for information only.

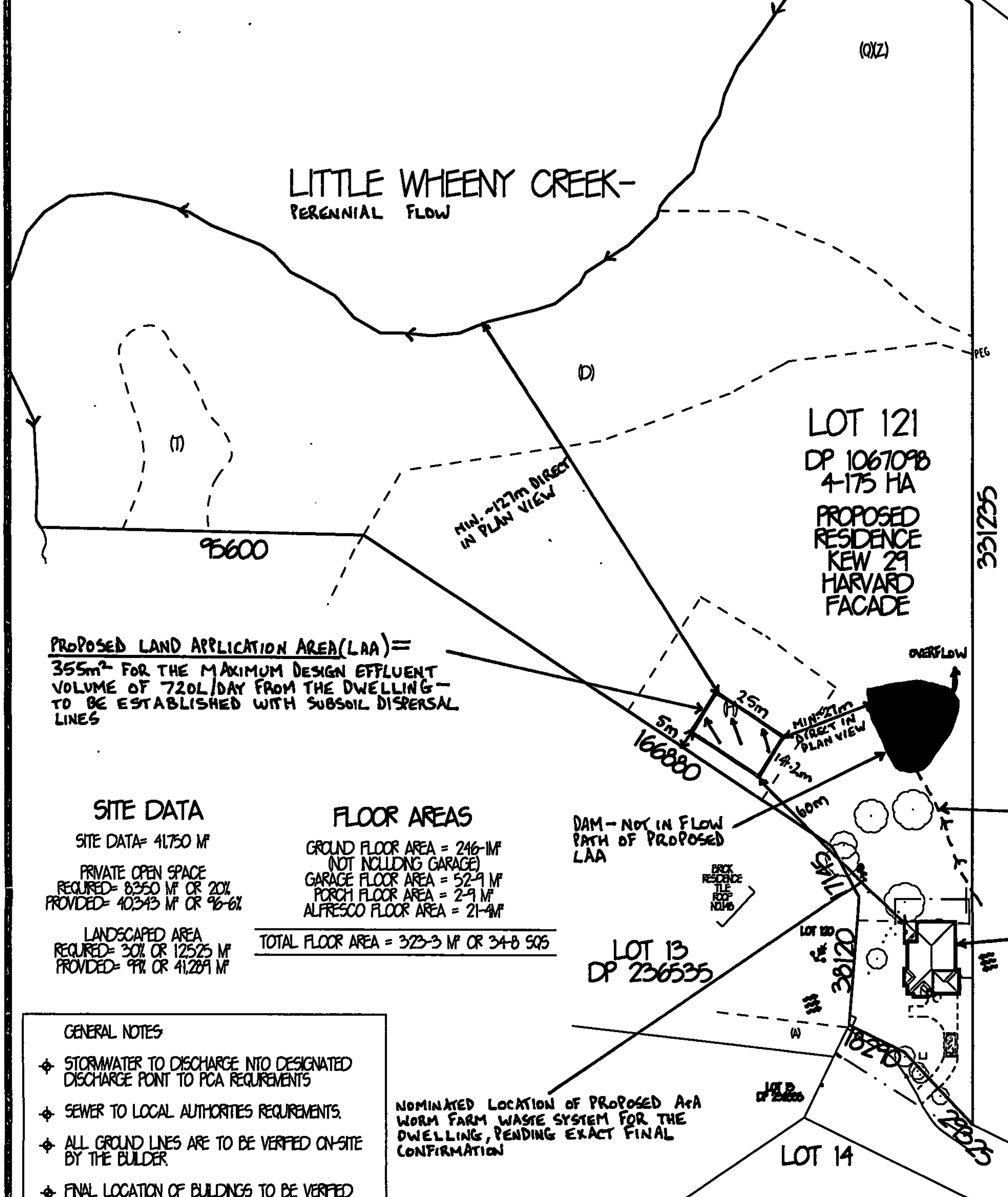
SOIL CLASSIFICATION

Field Texture Grade		Behaviour of moist bolus	Approximate clay content (%)
S	*Sand*	coherence nil to very slight; cannot be moulded; sand grains of medium size; single sand grains adhere to fingers.	commonly less than 5%
LS	*Loamy sand*	slight coherence; sand grains of medium size; can be sheared between thumbs and forefinger to give minimal ribbon of about 5mm.	about 5%
CS	*Clayey sand*	slight coherence; sand grains of medium size; sticky when wet; many sand grains stick to fingers; will form minimal ribbon of 5-15mm; discolours fingers with clay stain.	5%-10%
SL	*Sandy loam*	bolus coherent but very sandy to touch; will form ribbon of 15-25mm; dominant sand grains are of medium size and are readily visible.	10%-20%
L	*Loam*	bolus coherent and rather spongy; smooth feel when manipulated but with no obvious sandiness or 'silkiness'; may be somewhat greasy to the touch if much organic matter is present; will form ribbon of about 25mm.	about 25%
ZL	*Silty Loam*	coherent bolus; very smooth to often silky when manipulated; will form ribbon of about 25mm.	about 25% and with silt 25% or more
SCL	*Sandy clay loam*	strongly coherent bolus; sandy to touch; medium size sand grains visible in finer matrix; will form ribbon of 25-40mm.	20%-30%
CL	*Clay loam*	coherent plastic bolus; smooth to manipulate; will form ribbon of 40-50mm.	30%-35%
CLS	*Clay loam, sandy*	coherent plastic bolus; medium size sand grains visible in finer matrix; will form ribbon of 40-50mm.	30%-35%
ZCL	*Silty clay loam*	coherent plastic bolus; plastic and often silky to the touch; will form ribbon of 40-50mm.	30%-35% and with silt 25% or more
LC	*Light clay*	plastic bolus; smooth to touch; slight resistance to shearing between thumb and forefinger; will form ribbon of 50-75mm.	35-40%
LMC	*Light medium clay*	plastic bolus; smooth to touch; slight to moderate resistance to ribboning shear; will form ribbon of about 75mm.	40%-45%
MC	*Medium clay*	smooth plastic bolus; handles like plasticine and can be modelled into rods without fracture; has moderate resistance to ribboning shear; will form ribbon of 75mm or more.	45%-55%
MHC	*Medium heavy clay*	smooth plastic bolus; handles like plasticine; can be modelled into rods without fracture; has moderate to firm resistance to ribboning shear; will form ribbon of 75mm or more.	50% or more
HC	*Heavy clay*	smooth plastic bolus; handles like stiff plasticine; can be modelled into rods without fracture; has firm resistance to ribboning shear; will form ribbon of 75mm or more.	50% or more

From: Australian Soil and Land Survey: Field Handbook 1990

FIGURE 1

PLAN SHOWING THE LOCATION OF THE PROPOSED DWELLING AND LAND APPLICATION AREA FOR TREATED WASTEWATER AT LOT 121 DP 1067098, No. 144 MOUNTAIN VIEW CLOSE, KURRAJONG HILLS



SITE DATA

SITE DATA = 41,750 M²

PRIVATE OPEN SPACE
REQUIRED = 8350 M² OR 20%
PROVIDED = 40343 M² OR 96·6%

LANDSCAPED AREA
REQUIRED = 30% OR 12525 M²
PROVIDED = 99% OR 41,289 M²

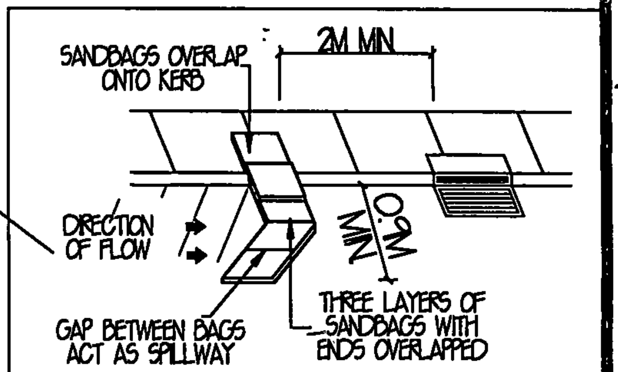
FLOOR AREAS

GROUND FLOOR AREA = 246·1M²
(NOT INCLUDING GARAGE)
GARAGE FLOOR AREA = 52·9 M²
PORCH FLOOR AREA = 2·9 M²
ALFRESCO FLOOR AREA = 21·4M²

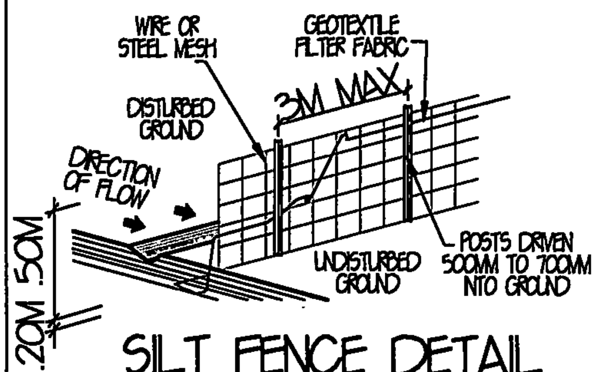
TOTAL FLOOR AREA = 323·3 M² OR 34·8 SQS

GENERAL NOTES

- STORMWATER TO DISCHARGE INTO DESIGNATED DISCHARGE POINT TO PCA REQUIREMENTS
- SEWER TO LOCAL AUTHORITIES REQUIREMENTS.
- ALL GROUND LINES ARE TO BE VERIFIED ON-SITE BY THE BUILDER.
- FINAL LOCATION OF BUILDINGS TO BE VERIFIED ON-SITE BY A REGISTERED SURVEYOR
- WRITTEN DIMENSIONS TO TAKE PRECEDENCE OVER SCALING. ANY PLAN DISCREPANCIES TO BE REFERRED BACK TO A&N DESIGN BEFORE PROCEEDING
- SITE CLASSIFICATION H1
- CUT AND FILL HOUSE PLATFORM APPROXIMATELY TO RL19·2 GARAGE TO RL19·2
- HOUSE FLOOR LEVEL RL19·585, 385MM ABOVE PLATFORM LEVEL. GARAGE FLOOR LEVEL APPROX. RL19·499, 299MM ABOVE PLATFORM LEVEL
- TOTAL ROOF AREA = 358·3 M²



KERB INLET SEDIMENT TRAP



SILT FENCE DETAIL

SEDIMENT CONTROL NOTES

ALL EROSION AND SEDIMENTATION CONTROL MEASUREMENTS, INCLUDING REVEGETATION AND STORAGE OF SOIL AND TOPSOIL, SHALL BE IMPLEMENTED TO THE STANDARDS OF THE SOIL CONSERVATION OF NSW.

ALL DRAINAGE WORKS SHALL BE CONSTRUCTED AROUND AND STABLISED AS EARLY AS POSSIBLE DURING DEVELOPMENT

SEDIMENT TRAPS SHALL BE CONSTRUCTED AROUND ALL INLET PITS, CONSISTING OF 300MM WIDE X 300MM DEEP TRENCH.

ALL SEDIMENT BASINS AND TRAPS SHALL BE CLEANED WHEN THE STRUCTURES ARE A MAXIMUM OF 60% FULL OF MATERIALS, INCLUDING THE MAINTENANCE PERIOD.

ALL DISTURBED AREAS SHALL BE REVEGETATED AS SOON AS THE RELEVANT WORKS ARE COMPLETED.

SOIL AND TOPSOIL STOCKPILES SHALL BE LOCATED AWAY FROM DRAINAGE LINES AND AREA WHERE WATER MAY CONCENTRATE.

FILTER SHALL BE CONSTRUCTED BY STRETCHING A FILTER FABRIC (PROPEX OR APPROVED EQUIVALENT BETWEEN POST AT 2M CENTRES). FABRIC SHALL BE BURIED 150MM ALONG ITS LOWER EDGE.

LOCALITY PLAN

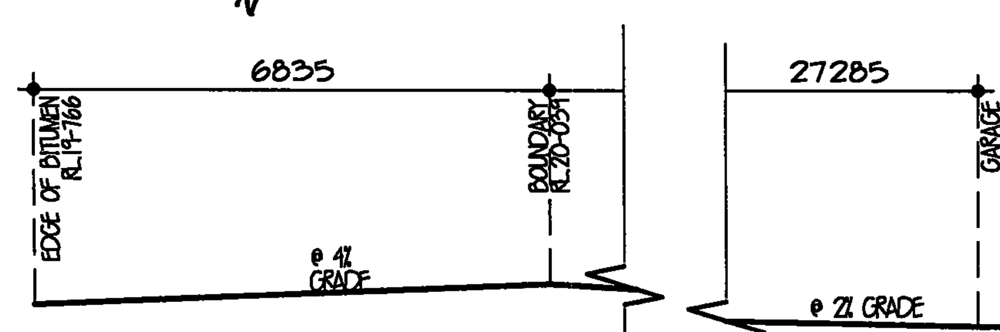
1:1500 (A3)

0 15 30 45 60
METRES

LGA: HAWKESBURY CITY COUNCIL
FIGURE 1: G. AUSTIN, BMG+ES P/L
EFFLUENT MANAGEMENT REPORT
APRIL 2019
PHONE 4782-5981

LEGEND
↑ TYPICAL LAND FALL DIRECTION ACROSS PROPOSED LAA

N



DRIVEWAY PROFILE 1:100

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AT	LOT 121, 144 MOUNTAIN VIEW CLOSE KURRAJONG HILLS
TYPE	KEW 29 (LIFESTYLE GENERATION SERIES)
JOB NO.	0023600
FACADE	HARVARD
HAND	RH
MASTER	A24938
DWG NO.	AND-30524
PAGE NO.	1 OF 8

A&N DESIGN GROUP SYDNEY
LEVEL 2 SUITE 216 MACARTHUR POINT NO. 25-27 SOLENT CIRCUIT BAULKHAM HILLS
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WWW.ANDESIGNSYDNEY.COM.AU

ISSUE	DATE	REVISION	DRAWN
A	1-2-19	SITING	CE
B	26-2-19	CC PLANS	DR/JZ