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REPORT ON INVESTIGATION AND ASSESSMENT FOR ON-SITE EFFLUENT MANAGEMENT AT LOT 3 DP 1023404, No. 10 WIRRINGULLA AVENUE, ELVINA BAY

PREPARED FOR: MR. M. & MRS. S. McKENSEY

SUBMITTED TO: NORTHERN BEACHES COUNCIL

REF. No. 201214

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CONTENTS

1. INTRODUCTION

This report outlines the results of an investigation and assessment for on-site effluent management at Lot 3 DP 1023404, No. 10 Wirringulla Avenue, Elvina Bay. The investigation was performed at the request of Mr. S. Crosby, acting on behalf of Mr. & Mrs. McKensey. The report will be submitted to Northern Beaches Council.

The unsewered property has an area of 713m^2 that is positioned at a waterfront locality in the southern side of Elvina Bay. Reference to the accompanying plan, Figure 1, shows that the property is occupied by an existing dwelling and associated features. The dwelling is serviced with an existing effluent management system that is understood to be operating properly.

The proposed development comprises the renovation and extension of the existing dwelling. The footprint of the dwelling when renovated and extended and associated features is also shown in Figure 1. Note that the extension works result in only a minimal increase in the final size of the dwelling relative to its current footprint.

The proposed renovation and extension works will not increase the number of bedrooms, which will remain the same as currently existing in the dwelling. Therefore, there will be no increase in the maximum potential occupancy level and associated design effluent volume.

2. PROPOSAL FOR EFFLUENT MANAGEMENT AND DESIGN WASTEWATER VOLUME

As confirmed with Mr. McKensey & Mr. Crosby, the proposal for effluent management from the dwelling when renovated and extended comprises the continued use of the existing effluent management system. It is assumed that this system was approved by Council when installed and has a current approval to operate.

The reason that it is aimed to utilise the current effluent management system is that the proposed renovation and extension works to the dwelling do not increase the maximum potential occupancy level and associated design effluent volume, whilst there will be no increase in the current number of occupants.

The existing effluent management system comprises the following components:

1. An aerated wastewater treatment system **(AWTS)** which consists of dual polymer tanks in the low-lying southeastern corner of the property adjacent to the mean high water mark at the location shown in Figure 1. As confirmed with Mr. G. Hobart, this is a SuperTreat SE10 AWTS which is accredited with the NSW Health Department, is serviced by him on a quarterly basis and is operating properly.
2. A land application area **(LAA)** for the secondary treated effluent.

With regards to the LAA, the following points are made based on observations on the property and liaison with Mr. McKensey, Mr. Crosby and Mr. Hobart:

- There are no definite signs of it. This can be viewed as a positive scenario in that if it was failing, then signs of failure would be evident by way of wet/boggy ground, weed plumes and surface runoff for example.
- There are no definite details about it by way of its exact location and size which are approximate.
- It is understood to consist of subsurface dispersal lines and not spray irrigation lines or an absorption trench or trenches.
- It is understood to be in the northwestern corner of the property to the west of the alignment of the dwelling and north of the pathway to the dwelling from Wirringulla Avenue. Based on this, its probable location is indicated in Figure 1, which is approximate along with its estimation of the size.
- Further to the point above, it is possible that it may not be fully to the west of the alignment of the dwelling. Therefore, it also possible that it may happen to be covered by the proposed extensions to the north of the western end of the existing dwelling and also by the proposed stone steps. In light of this possibility, the extension works have to be carried out very carefully in case it damages part of the existing area used for land application. Nonetheless, careful observations on the property indicate that whilst

possible, it is probably unlikely the existing subsurface dispersal lines would extend east of the alignment of the rear of the dwelling and be in the line of the extensions. This is due to the occurrence of trees, other vegetation, 'steps' in the landform, retaining walls and pathway that would make the laying of subsurface dispersal lines logistically difficult.

This report is submitted to Council as part of the approval process for the dwelling to be renovated and extended, as well as the aim to retain the existing effluent management system for continued use. Blue Mountains Geological and Environmental Services is not responsible or liable for the installation, operation, maintenance and on-going performance of both the existing AWTS and area utilised for land application.

The main environmental concern with the AWTS in general is considered to be the levels of nitrates, phosphates and faecal coliforms generated, particularly if prescribed treatment levels are not achieved. Reference to the Guidelines in Department of Local Government et. al. (1998) shows the expected quality of wastewater after treatment in an AWTS, which is given in Table 1. Design figures may not be indicative of long-term operational characteristics, and an AWTS must be well maintained and operated to achieve this quality on a continuous basis. Note that the aerated systems currently on the market and accredited by the NSW Health Department provide a better wastewater quality with nitrogen **(N)** and phosphorus **(P)** concentrations typically not exceeding 15 - 20mg/litre and 10 - 12mg/litre respectively.

Aerated systems rely on biological activity for proper system operation. Changes to the effluent loadings, in the form of either a significant increase or decrease, may result in poor system performance. It is suggested that an AWTS must be operated continuously and the power must not be turned off, as intermittent use may require servicing of the system at each start up.

TABLE 1: EXPECTED QUALITY OF WASTEWATER AFTER TREATMENT IN AN AERATED SYSTEM

PARAMETER	**CONCENTRATION**	**FAILURE INDICATOR**
BIOCHEMICAL OXYGEN DEMAND	<20mg/L	>50mg/L
SUSPENDED SOLIDS	<30mg/L	>50mg/L
TOTAL NITROGEN	25 - 50mg/L*	not applicable
TOTAL PHOSPHORUS	10 - 15mg/L*	not applicable
FAECAL COLIFORMS NON-DISINFECTED EFFLUENT	up to 10^4 cfu/100mL	not applicable
FAECAL COLIFORMS DISINFECTED EFFLUENT	<30cfu/100mL	>100cfu/100mL
DISSOLVED OXYGEN	>2mg/L	<2mg/L

* Improved treatment levels with currently accredited systems.

It would be prudent, as with on-site or reticulated sewer, to continue the water usage minimisation scheme in the dwelling. Whilst the AWTS provides for re-use of all domestic effluent by application to the land, reducing the loads to be treated and discharged will significantly decrease the potential for adverse environmental impacts. It is understood that the dwelling already has a set of water limiting devices/appliances, which will also be provided where applicable for new plumbing associated with the renovation and extension works.

Note that the requirement for minimising water usage and effluent generation is considered to be more pronounced in offshore areas such as Elvina Bay due to the tank water supply and small size of the residential unsewered properties and setting within Pittwater.

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 into the existing AWTS and area to be utilised for land application. 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. McKensey & Mr. Crosby, the following details are provided in relation to wastewater generation at the subject site:

- The dwelling is serviced with a tank water supply.
- The existing dwelling comprises four bedrooms.
- When renovated and extended, the dwelling will still have four bedrooms.
- When renovated and extended, the dwelling will continue to be occupied by the four members of the McKensey family.

Design effluent volume calculations are based on the maximum potential occupancy level of the 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 this assessment, the maximum potential occupancy level of the 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 domestic wastewater design flow allowance from dwellings with a tank water supply is 120 litres/person/day.

Based on the details above, the design output of effluent for the maximum of six full-time occupants in the existing dwelling and when it is renovated and extended is:

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

It is imperative to ensure that appropriate water-conservation practices are continued in the dwelling when renovated and extended so the maximum design effluent volume above is not exceeded – i.e. ideally kept as low as possible. For the four persons residing in the dwelling, the design output of effluent is 480 litres/day, or two-thirds of the maximum.

3. SITE DESCRIPTION

The property comprises an elongate-shaped parcel of land that has a frontage of 17.95m onto Wirringulla Avenue and extends downslope in a northeasterly direction to the mean water mark at Elvina Bay for distances ranging from 43.585 - 45.54m.

The approximate estimated location and size of the existing LAA for subsurface dispersal at 40m^2 in the elevated northwestern corner of the property is shown in Figure 1. It is estimated that this area has the following approximate estimated buffer distances:

- 1m from the upslope western boundary fronting Wirringulla Avenue.
- 1m from the northern boundary, where the land falls only marginally towards it. Note that the adjoining Lot to the north (i.e. Lot 2 DP 1023404) comprises a relatively small parcel of land which does not have a dwelling on it and is not large enough to ever have a dwelling.
- 2m upslope of the proposed extensions to the dwelling.
- 1m upslope of the proposed stone steps associated with the extensions
- A minimum of 0.5m from the closest points of the existing pathway to the southeast, where the land does not fall towards it.
- 35m to the mean high water mark at Elvina Bay – note that this distance in plan view is considerably increased along the ground surface.

The approximate estimated position of the LAA has a typical overall grade of about 1 in 3 in a north-northeasterly direction based on the contours at 0.5m intervals in Figure 1. This area and adjacent parts on a convex sideslope comprises a minor grassy cover with some low weeds, bare patches and some scattered trees, whilst being relatively well-elevated and affording exposure to the northerly to easterly aspect and prevailing winds which will enhance the benefits of evapotranspiration.

Climatic conditions at the site are generally temperate throughout the year. The average annual rainfall in Pittwater is approximately 1225mm, whilst the annual evaporation is 1790mm which exceeds rainfall in all months except May and June.

4. FIELDWORK METHODS

The initial phase of the fieldwork comprised a site inspection and ground survey on 27/11/20 aimed at assessing the nature of the area understood to comprise the subsurface dispersal lines.

Further to the ground survey, three 100mm diameter hand-auger holes were bored to a maximum depth of 1.2m across the area understood to comprise the existing LAA. The auger holes were used to determine the physical characteristics of the subsurface strata.

5. GROUND SURVEY AND PHYSICAL CONSTRAINTS

Results from the ground survey indicate that the main physical constraints to on-site effluent management on the property as a whole comprise the typically steep nature of the terrain and waterfront setting in the southern part of Elvina Bay. These constraints are exacerbated by the small area of the unsewered property and extent of the existing dwelling with proposed extensions and associated features, as well as the implementation of set-back distances from these and property boundaries.

In light of the physical constraints and associated factors, there is considered to be limited potential for the provision of extra land for effluent disposal beyond the existing LAA that is estimated to have an approximate area of $40m^2$.

6. SUBSURFACE PROFILE

Reference to the Sydney 1:100,000 scale Soil Landscape map indicates that the property as a whole is underlain by the colluvial 'Watagan' group which occurs on rolling to very steep hills on fine-grained Narrabeen Group sediments (mainly interbedded laminite and shale with quartz to lithic quartz sandstone).

The soils of the Watagan group comprise shallow to deep (30 - 200cm), Lithosols/Siliceous Sands and Yellow Podzolic Soils on sandstones; moderately deep (100 - 200cm) Brown Podzolic Soils, Red Podzolic Soils and Gleyed Podzolic Soils on shales (Chapman and Murphy, 1989). Findings from the auger holes are considered to best equate with Yellow Podzolic Soils on sandstone bedrock.

The Watagan group is limited by mass movement hazard, steep slopes, severe soil erosion hazard, very strong acidity, low fertility, high aluminium toxicity and occasional rock outcrop (Chapman and Murphy, 1989).

The subsurface profile observed in the auger holes has a 'duplex' structure, as there is a well-defined textural and permeability contrast between the A and B soil horizons. With reference to Table E4 in AS/NZS 1547 (2012), it is considered that the A1 and A2 horizon soils have a single grained structure whilst the B soil horizon has a strong structure.

The soils are described in accordance with the classification schemes in Australian Soil and Land Survey: Field Handbook (1990) and Table E1 in AS/NZS 1547, 2012 (Appendix 1). The typical subsurface profile observed in the auger holes across the area known to be utilised for effluent disposal is detailed below.

(i) LOAMY SAND (TOPSOIL) – A1 Horizon

- observed from the surface to an average depth of 0.2m.
- comprises dark grey-brown, fine to medium grained loamy sand with few ironstone and weathered sandstone fragments (i.e. 2 - 10% coarse fragments from Table E2 in AS/NZS 1547, 2012).
- soil category 2 for sandy loams from Table E1 in AS/NZS 1547 (2012).

(ii) SANDY LOAM – A2 Horizon

- observed from an average depth of 0.2 - 0.4m.
- comprises dark-brown to dark grey-brown, fine to medium grained sandy loam with few ironstone and weathered sandstone fragments (i.e. 2 - 10% coarse fragments).
- soil category 2 for sandy loams.

(iii) LIGHT CLAY – B Horizon

- observed from an average of 0.4m to a maximum depth of 1.2m.
- comprises firm to stiff, brown to orange-brown light clay with few ironstone and weathered sandstone fragments (i.e. 2 - 10% coarse fragments).
- soil category 5 for light clays.

7. APPRAISAL OF THE EXISTING LAND APPLICATION AREA

Reference to Figure 1 shows the estimated approximate position of the LAA that is understood to comprise subsurface dispersal lines. As detailed in Section 5, there is considered to be limited potential for the provision of extra land for effluent disposal beyond the existing LAA that is estimated to have an approximate area of $40m^2$.

With the proposed renovation and extension works not increasing the maximum design effluent volume from the dwelling or existing number of occupants, it can be argued that there is no imperative to increase the size of the existing area used for the land application of treated effluent. As outlined in Section 2, there are no definite details about the nature of the LAA which are therefore inferred. However, there are no obvious signs of failure which infers that the land application of treated effluent is being properly catered for.

Whilst there is limited potential for additional areas for effluent disposal, the following points are made:

- There is some potential for extra area for surface spray irrigation to the southeast of the existing inferred area in the general area upslope of the dwelling and in the vicinity of the water tanks. This is considered to be an effective method of land application that can cater for relatively high volumes of secondary treated effluent over small areas. A semi-fixed irrigation arrangement would be ideal with the lines being placed on the surface.
- There is also some potential for extra area for surface spray irrigation off the downslope northeastern side of the dwelling closer to the waterfront adjacent to the pathway to the dwelling from Elvina Bay. The same additional comments apply to this potential area as outlined in the point above.

Whilst the exact nature of the current arrangement for the land application of secondary treated effluent is not definitely known, provision of an additional area or areas for effluent disposal as noted in the points above could be considered if there were ever signs of failure, or if the renovation and extension works happen to damage the existing subsurface dispersal lines.

The management of the estimated area containing the current LAA is an important aspect that influences its performance. Details in this regard are outlined below.

7.1 Management of the Land Application Area

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 disposal 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.

Details in regards to the optimisation and management of the existing LAA and adjacent parts are outlined below:

- Maintain any upslope runoff and any soil seepage away from it so it only has to cater for treated wastewater and direct rainfall.
- Apply lime and gypsum to reduce acidity and decrease the potential for dispersion at suggested respective rates of approximately 0.3 - 0.4kg/m^2 (i.e. 3 - 4kg/m^3) and 0.1 - 2kg/m^2 respectively (i.e. 1 - 2kg/m^3).
- Ensure that stormwater provisions associated with the dwelling and tank water supply are not directed towards it and impede its proper functioning.
- In the event of weed proliferation due to the discharge of treated effluent, implement adequate eradication measures to prevent their possible spread.
- Ensure there are no bare patches on the surface. This can be achieved by having a complete grass growth that can be established by seeding or topdressing (say 50mm of sand-based soil such as 'turf underlay' for example) and laying turf such as 'Sir Walter' buffalo or similar.
- Manage the grass by mowing or whipper-snippering regularly to promote vigorous growth with the cuttings harvested and removed to avoid nutrient recycling. Ensure that grass is not cut to a level that is too low as this will limit the depth and density of root growth.
- Construction activities must not adversely impact, particularly with regards to soil disturbance, the compaction/stripping of topsoil and the loss of overall soil depth.

Note that evapotranspiration, which will be enhanced at the subject site as a function of the overall temperate climate and vegetation cover, will provide a concurrent reduction in the hydraulic loading rate and volumes of treated effluent permeating to the subsoil.

8. OPERATION AND MAINTENANCE OF THE AERATED SYSTEM

For the effluent management system to work well the supplier, installer, service agent, owners and residents must be committed to its management, whilst an AWTS must be serviced on a quarterly basis. Quarterly services as part of maintenance agreements normally involve inspection of the mechanical, electrical and functioning parts of the system to ensure they are operating properly, replacement of chlorine tablets for disinfection and a check of the LAA. A properly operated and maintained system should meet the expected parameters for wastewater quality (see Table 1, Section 2).

The effectiveness of the AWTS will, in part, depend on how it is used and maintained. A guide to good maintenance procedures, from Department of Local Government (1998), is listed below:

DO

- continue to have the AWTS inspected and serviced four times per year by an approved contractor.
- continue to have the system service include assessment of sludge and scum levels and performance of the LAA.
- have the AWTS desludged at least every three years.
- continue to have the disinfection chamber inspected and tested quarterly to ensure correct disinfection levels.
- keep a record of pumping, inspections, and other maintenance.
- learn the location and layout of the treatment system and LAA.
- use biodegradable liquid detergents such as concentrates with low sodium and P levels (see Appendix 1).
- conserve water – deliberate attention to this issue is imperative due to the small size of the unsewered property on Elvina Bay, the limited nature of the tank water supply and to also provide a way to enhance the performance/life span of the AWTS and assist to ensure that the LAA does not become hydraulically overloaded.

DON'T

- put bleaches, disinfectants and spot removers for example in large quantities into the AWTS via the sinks or toilet.
- allow any foreign material such as nappies, sanitary napkins, condoms and other hygiene products to enter the system.
- use more than the recommended amounts of detergents.
- put fats and oils down the drain and keep food waste out of the system – this is considered to be particularly important because food scraps can result in a higher than acceptable biochemical oxygen demand levels and excess oils/fats/greases can overload or hinder the performance of any type of effluent treatment system. Use of a strainer in the kitchen sink is required and promoting the removal of excess food waste/oils from plates with paper towelling before washing would reduce the input of fats and organic material into the AWTS (paper towelling can be composted).
- switch off the power to the AWTS, even when the dwelling is unoccupied.

9. CONCLUSION

(i) An investigation and assessment has been undertaken for on-site effluent management at Lot 3 DP 1023404, No. 10 Wirringulla Avenue, Elvina Bay. The unsewered property has an area of 713m^2.

(ii) The property is occupied by an existing four bedroom dwelling and associated features, whilst being serviced with an AWTS and what is understood to be a subsurface dispersal area that are known to be operating properly.

(iii) The proposed development comprises the renovation and extension of the existing dwelling. These works will not increase the number of bedrooms, which will remain the same as currently existing in the dwelling. Therefore, there will be no increase in the maximum potential occupancy level and associated design effluent volume.

(iv) The design output of effluent with allowance for a maximum of six full-time occupants in the existing dwelling and when it is renovated and extended is 720 litres/day. For the four persons who will continue to reside in the dwelling when renovated and extended, the design output of effluent is 480 litres/day, or two-thirds of the maximum.

(v) The proposal for effluent management from the dwelling when renovated and extended comprises the continued use of the existing effluent management system. With regards to the LAA, there are no definite details about it by way of its exact location and size which are approximate. However, the estimated approximate size of the existing subsurface dispersal is $40m^2$.

(vi) Whilst the exact nature of the current arrangement for the land application of secondary treated effluent is not definitely known, provision of an additional area or areas for effluent disposal could be considered if there were ever signs of failure, or if the renovation and extension works happen to damage the existing subsurface dispersal lines.

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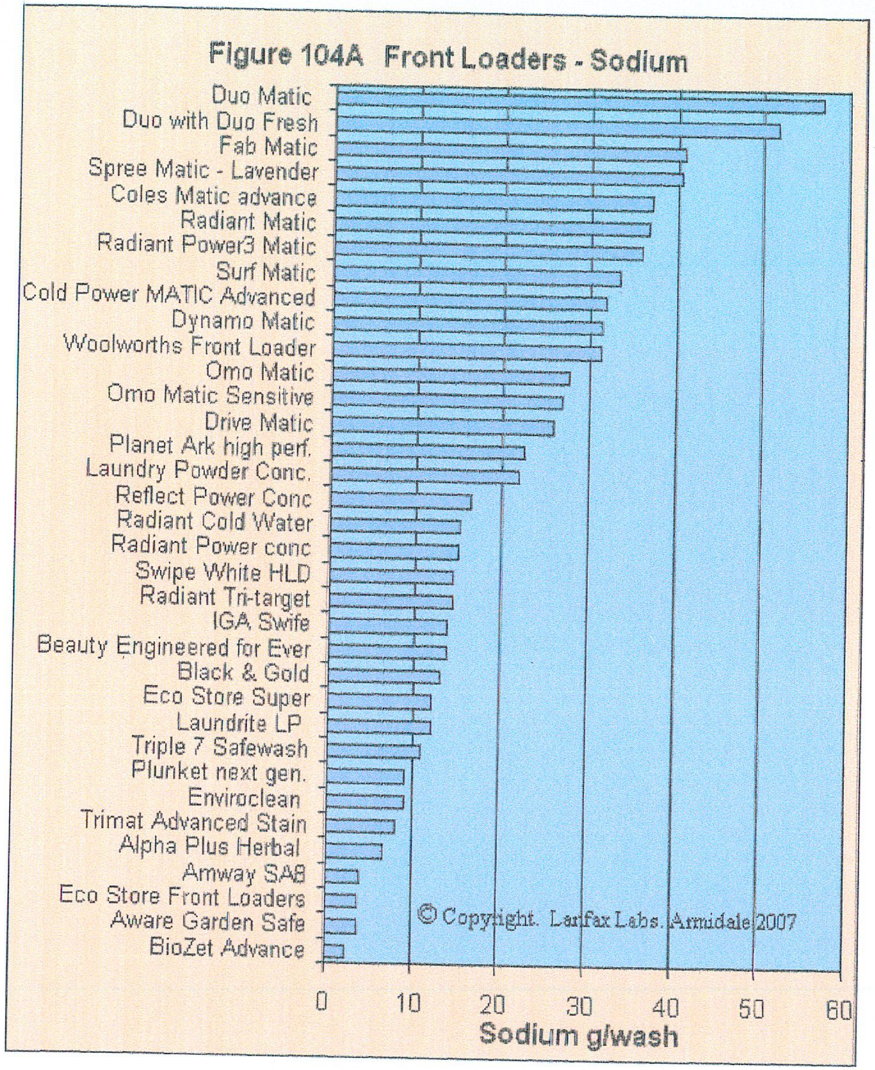
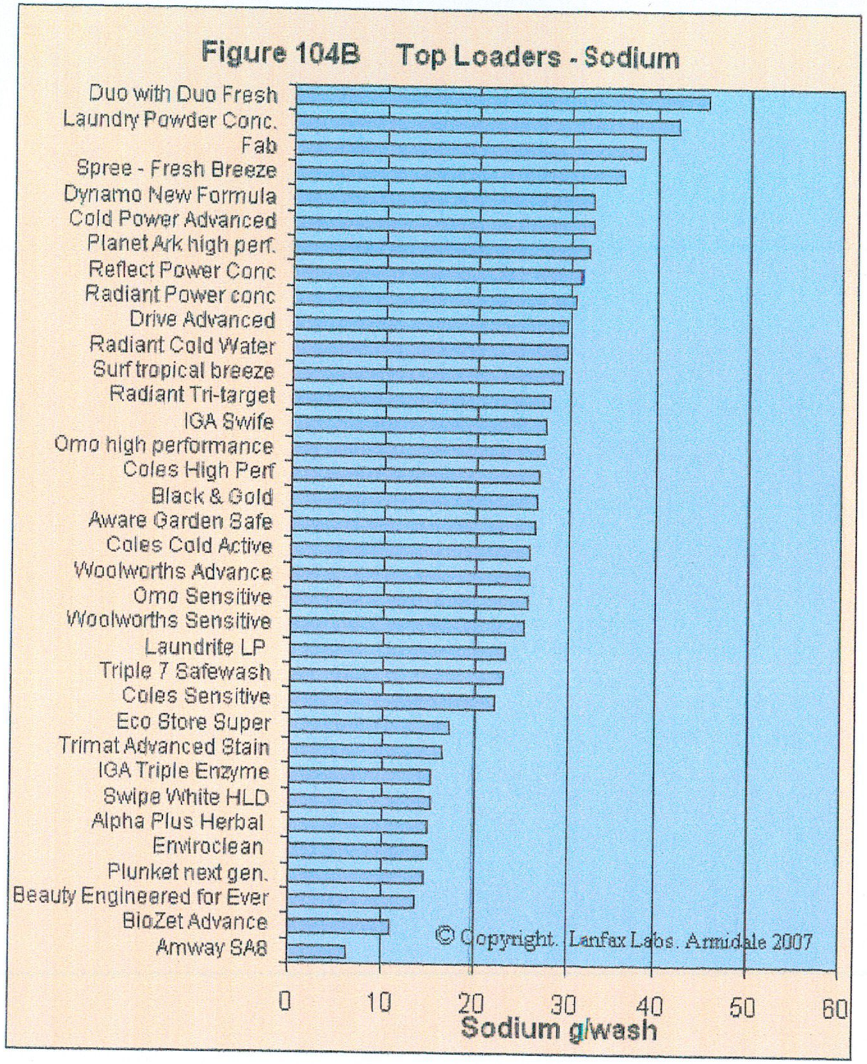
APPENDIX 1

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

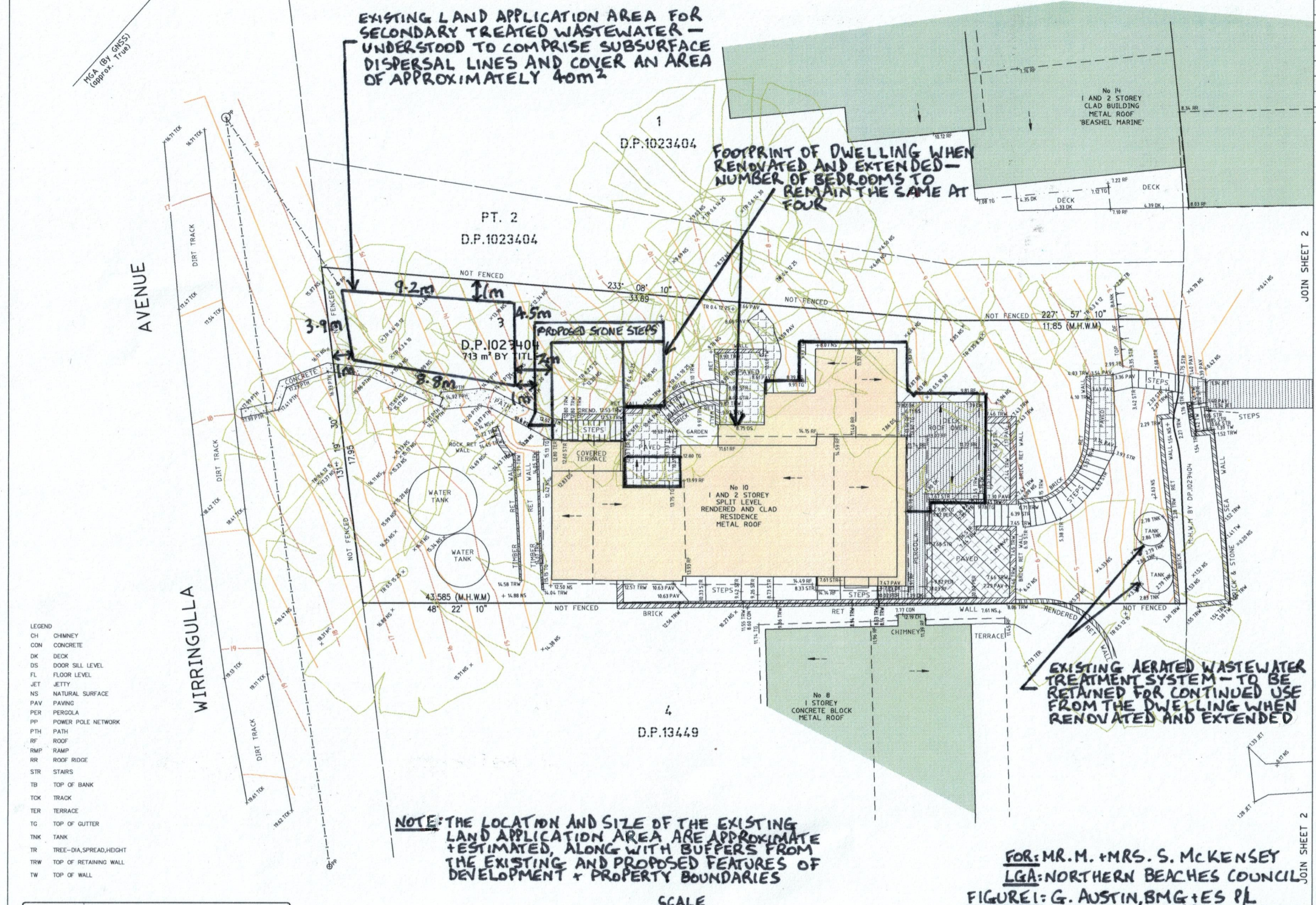
NOTE: The typical clay content figures are included for information only.

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 FOOTPRINT OF THE DWELLING WHEN RENOVATED AND EXTENDED, ASSOCIATED FEATURES AND COMPONENTS OF THE EFFLUENT MANAGEMENT SYSTEM AT LOT 3 DP 1023404, No. 10 WIRRINGULLA AVENUE, ELVINA BAY



TITLE INDICATES THAT LOT 3 IN D.P.1023404 IS SUBJECT TO:
- RESERVATIONS AND CONDITIONS IN THE CROWN GRANT(S).
- LAND EXCLUDES MINERALS AFFECTING THE PART SHOWN IN THE TITLE DIAGRAM - SEE CROWN GRANT(S)
- C955847 COVENANT (NOT INVESTIGATED)

FOR: MR. M. + MRS. S. McKENSEY
LGA: NORTHERN BEACHES COUNCIL
FIGURE 1: G. AUSTIN, BMG + ES P/L EFFLUENT MANAGEMENT REPORT REF. No. 201214 DECEMBER 2020 PHONE 4782-5981

A	FIRST ISSUE	24/06/19

- BOUNDARIES HAVE NOT BEEN DEFINED, A PRELIMINARY BOUNDARY SURVEY FOR DESIGN AND DA PURPOSES HAS BEEN UNDERTAKEN. LOT DIMENSIONS HAVE BEEN TAKEN FROM THE TITLE DIAGRAM. SITE AREA HAS BEEN CALCULATED FROM THESE DIMENSIONS - BOUNDARY DEFINITION IS SUBJECT TO FURTHER SURVEY.
- IF CONSTRUCTION ON OR NEAR BOUNDARIES IS REQUIRED IT IS RECOMMENDED THAT THE BOUNDARIES OF THE LAND BE MARKED.
- TREE SIZES ARE ESTIMATES ONLY.
- THIS PLAN HAS BEEN PREPARED FOR THE EXCLUSIVE USE OF MIKE MCKENSEY
- RELATIONSHIP OF IMPROVEMENTS TO BOUNDARIES IS DIAGRAMMATIC ONLY. WHERE OFFSETS ARE CRITICAL THEY SHOULD BE CONFIRMED BY FURTHER SURVEY.
- EXCEPT WHERE SHOWN BY DIMENSION LOCATION OF DETAIL WITH RESPECT TO BOUNDARIES IS INDICATIVE ONLY.
- ONLY VISIBLE SERVICES HAVE BEEN LOCATED. UNDERGROUND SERVICES HAVE NOT BEEN LOCATED. DIAL BEFORE YOU DIG SERVICES (ph 1100) SHOULD BE USED AND A FULL UTILITY INVESTIGATION, INCLUDING A UTILITY LOCATION SURVEY, SHOULD BE UNDERTAKEN BEFORE CARRYING OUT ANY CONSTRUCTION ACTIVITY IN OR NEAR THE SURVEYED AREA.
- CRITICAL SPOT LEVELS SHOULD BE CONFIRMED WITH SURVEYOR.
- THIS PLAN IS ONLY TO BE USED FOR THE PURPOSE OF DESIGNING NEW CONSTRUCTIONS.
- CONTOURS SHOWN DEPICT THE TOPOGRAPHY. EXCEPT AT SPOT LEVELS SHOWN, THEY DO NOT REPRESENT THE EXACT LEVEL AT ANY PARTICULAR POINT. ONLY SPOT LEVELS SHOULD BE USED FOR CALCULATIONS OF QUANTITIES WITH CAUTION.
- CONTOUR INTERVAL - 0.5 metre. - SPOT LEVELS SHOULD BE ADOPTED.
- POSITION OF RIDGE LINES ARE DIAGRAMMATIC ONLY (NOT TO SCALE).
- THE INFORMATION IS ONLY TO BE USED AT A SCALE ACCURACY OF 1:100.
- DO NOT SCALE OFF THIS PLAN / FIGURED DIMENSIONS TO BE TAKEN IN PREFERENCE TO SCALED READINGS.
- IF ACCURATE TRUE NORTH IS REQUIRED A FURTHER SURVEY WOULD BE NECESSARY.

Waterview SURVEYING SERVICES
1A Mona Street Mona Vale NSW 2103
ACN 610 583 572
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0474 843 180

Vertical Datum
DATUM: AUSTRALIAN HEIGHT DATUM (AHD)
N/A
R.L. N/A
SOURCE: DERIVED ON SITE VIA NRTK GNSS OBSERVATIONS, CORSNet-NSW

Client Details
MIKE MCKENSEY
10 WIRRINGULLA AVENUE
ELVINA BAY NSW 2105

Drawing Title
DETAIL AND LEVELS OVER
10 WIRRINGULLA AVENUE
ELVINA BAY NSW 2105
BEING LOT 3 IN DP.1023404

PROJECT: 981	PAGE 1 OF 2
Date of survey 18/06/2019	Drawing No. 981detail 1
Scale 1:100 ~~@ A1~~	Rev. A