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3 April 2006

Shoalhaven City Council
Eric Hollinger (Strategic Project Planner)
PO Box 42
Nowra, NSW 2541

Dear Eric,

RE: REVIEW OF BEST PRACTICE METHODS OF ON-SITE SEWAGE DISPOSAL – JERBERRA ESTATE REZONING INVESTIGATIONS (DRAFT LEP LP155)

BACKGROUND AND SCOPE

We provide the following review of on-site effluent management alternatives for the study area within the context of existing environmental information, this being:

1. ERM Mitchell McCotter (1994) Local Environmental Study.

2. Coffey (2000) Effluent Disposal Study, Jerberra Estate, St. Georges Basin.

Key aspects of our review include:

1. The adequacy of effluent disposal requirements discussed in the Coffey (2000) report, within the context of current standards.

2. Assessment of and recommendations for best practice on-site wastewater treatment alternatives for the site, taking into account spatial variations in soil, gradient and buffer requirements.

EXISTING SITE AND ENVIRONMENT CONDITIONS

The following salient points pertain to on-site effluent management within the study area.

1. The site contains 153 allotments ranging between 860 – 17,600 m^2, with 102 allotments less than 4000 m^2 in area (some lots adjacent to Pine Forest Road are < 900 m^2 although exact areas have not been determined by survey).

2. Three primary soil units occur on the site:

    a. Moderate depth podzolics of clayey sand (to say 0.3 m depth) overlying silty clay to between 0.9 – 1.5 m depth. These overlay sandstone which is broadly expressed in the NW-SE aligned ridgeline.

    b. Deep podzolics of clayey sand (to say 0.3 m depth) overlying silty clay to between 1.8 – > 2.2 m depth. These broadly occur along the side slopes of

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the NW-SE aligned ridgeline.

   c. Poorly drained highly plastic clay soils occurring in low lying land subject to overland flows and flooding. Soil depth in these areas generally exceeds 2.0 m.

3. Two drainage depressions / intermittent water courses occur on the site.

4. Site slopes are generally < 10 % and suitable for a range of effluent re-use methods (see Attachment A).

5. Several unsealed roads traverse the study area.

6. Whilst some buildings have been erected on some of the allotments, much of the study area remains in an unbuilt form and extensively covered with native vegetation. Approximately 65 lots contain unauthorised structures. There is 1 approved dwelling within the estate.

KEY COFFEY RECOMMENDATIONS AND COMMENTS

The following points summarise recommendations of the Coffey (2000) report and our comments:

1. Simple annual nutrient (N and P) balance calculations indicated minimum effluent disposal area of 695 m^2 on the basis of P (using an irrigation P concentration of 12 mg/L) and 1480 m^2 on the basis of N (using an irrigation N concentration of 37 mg/L). The monthly water balance calculations provided by Coffey's indicated a minimum effluent disposal area per house of 414 m^2.

   Our view is that there is considerable discrepancy between the outcomes of the water and nutrient balance calculations. More detailed N and P balance modelling (using say a daily model) is likely to show that smaller areas are required for re-use. Further to this, Coffeys did not investigate the potential of providing a higher quality effluent, which in turn would further reduce the nutrient loads within irrigated effluent and therefore the irrigation area requirement.

2. Two feasible effluent management options were proposed by Coffey's:

   a. Individual AWTS systems servicing each allotment. These would require a minimum allotment size of 2500 m^2 of which 1500 m^2 would be required for effluent disposal. A wet-weather storage of 53 m^3 per site was recommended. An earth bund around each disposal field was recommended to provided storage within the irrigation area.

      Our view is that the effluent application area of 1500 m^2 is probably excessive on the basis of current approaches to wastewater management and the sites reasonable soil effluent renovation potential. Our view is that based on current best practice, both the wet-weather storage and the earth bund proposed around the irrigation field would be unnecessary. Finally, we note that Coffey's did not investigate a range of other alternatives to the AWTS option.

b. A common effluent scheme for the estate. An assumption was made by Coffey's that 1500 m^2 per lot would be required for effluent disposal. On this basis, Coffey's recommended that the site could only support 85 allotments because effluent could only be disposed of within the ridge line area of the site.

Our view is that the flaw in the above argument is that the 1500 m^2 / dwelling assumption is extremely general, does not discuss the considerable differences and benefits offered by a CES, and unlikely accurately reflect engineering practice. Our view is that it is not possible to extrapolate linearly from a single household design to the design of a CES.

Further to this, it is our view that on the basis of the existing soil data, that many areas of the site outside of that proposed by Coffey's could be used for irrigation by the CES. Coffey's have taken the view that all effluent from the CES would be irrigated within a single area. For a site such as this one, where land has already be sub-divided, the most practical solution when implementing the CES would be to treat effluent centrally and then, through a dual reticulation system, allow for reclaimed water to be re-used on individual allotments.

EFFLUENT TREATMENT STANDARD

The Coffey report does not discuss the implications of applying effluent at a range of treatment / quality standards. Calculations in the Coffey report assume secondary effluent treatment with no further nutrient removal. However, nutrients were the limiting factor in the determination of the 1500 m^2 recommended for effluent irrigation. This implies that lower nutrient concentrations may result in reduced irrigation areas per lot.

WATER SENSITIVE URBAN DESIGN AND WATER CONSERVATION

The Coffey report does not discuss the implications of BASIX (which was not gazetted at the time of report preparation), standard water reduction devices and re-use opportunities (eg. toilet flushing re-use) for effluent management. In both the water and nutrient balances presented by Coffey's, 1000 L wastewater production has been assumed per dwelling. Using AS/NZS 1547 (2000), the following rates for a five person family (ie. 5 EP dwelling) would apply for a house supplied with reticulated town water:

No water reduction fixtures	900 L/d
Standard water reduction fixtures	725 L/d
Full water reduction fixtures	550 L/d

These values are considerably less than the 1000 L/dwelling assumed by Coffey's. Toilet flushing re-use would account for some 30 % reduction in wastewater production from the above. On the basis of a typical minimum irrigation areas for a 3 and 4 bedroom dwelling are indicated in Table 1 and are based on an example design irrigation rate (DIR) of 20 mm/week. We note that the adopted DIR is for illustrative purposes only.

Table 1: Summary of individual system alternatives.

Category	3 Bedroom Dwelling (5 ep)	4 Bedroom Dwelling (6 ep)
No water reduction fixtures	Flow 900 L/d, Area 315 m^2	Flow 1080 L/d, Area 378 m^2
Standard water reduction fixtures	Flow 725 L/d, Area 254 m^2	Flow 870 L/d, Area 305 m^2
Full water reduction fixtures	Flow 550 L/d, Area 293 m^2	Flow 660 L/d, Area 231 m^2

SINGLE ALLOTMENT SYSTEMS

A range of single allotment systems exist on the current market that may be suitable for the site. These fall into the following broad categories:

1. Standard secondary treatment systems (S)

   These generally include AWTS, single-pass / recirculating sand / rock filter systems and biological systems (eg. Biolytix and Aqua Clarus) which are capable of producing secondary quality effluent. Effluent disposal is by way of irrigation either to surface (if disinfected) or sub-surface (if not disinfected).

2. Water reduction systems (W)

   These generally apply to systems which reduce or remove the blackwater component of the wastestream. Examples include composting toilets and the hybrid toilet. In the case of the hybrid toilet, these differ from composting toilets in that toilet wastewater is discharged into a large water filled chamber with an extended residence time. This process allows for a very long blackwater retention time and high levels of anaerobic digestion prior to discharge. Hybrid toilets either utilise direct drop installations (ie. no blackwater produced) or a mini-flush system (where say 0.3 L/flush is produced).

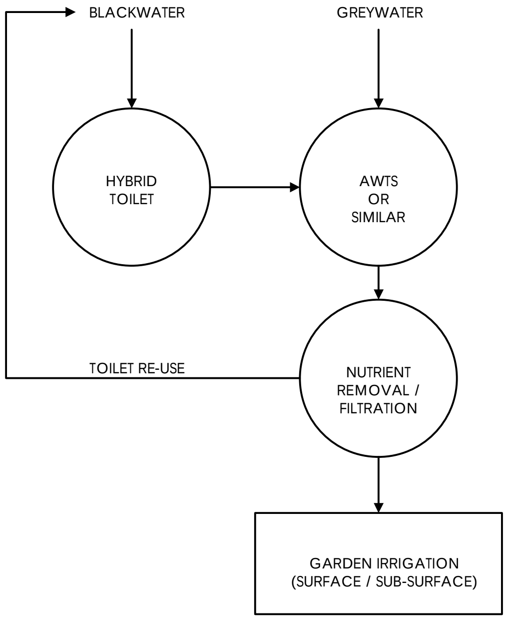
3. Nutrient Removal Systems (N)

   A range of nutrient removal systems for both nitrogen (N) and phosphorus (P) removal exist on the market. These include for example Ecomax, Garden Master (nutrient removal models), BushWater and other AWTS derivatives to name but a few. The use of non-proprietary amended media filters (containing for example BHP blast furnace slag or other products) for advanced nutrient and pathogen removal can also be used downstream of the AWTS.

   Generally, all of the above systems produce high grade effluent with N < 5-10 mg/L and P < 5 mg/L (or better). Any of these systems would be suitable for the study area and would have the benefit of producing higher grade effluent which would result in the reduction of effluent disposal area size and [in some cases] provide the opportunity for toilet flushing re-use.

4. Combination Water Reduction / Nutrient Removal Systems (C)

   These systems involve a combining the benefits of water reduction with advanced nutrient / pathogen removal. An example is given below for a typical arrangement on a single allotment:



A summary of the above system types is provided below in Table 2.

Table 2: Summary of individual system alternatives.

Issue	Standard Secondary Treatment Systems	Nutrient Removal Systems	Combined Water Reduction / Low Nutrient
Requires Power	Yes	Yes	Yes
Maintenance Requirements	3 monthly	3 monthly	3 monthly
Effluent Quality	Secondary[1]	Tertiary[2]	Tertiary[2]
Re-use Potential	Irrigation	Irrigation / Some Possibly Toilet Re-use	Irrigation / Some Possibly Toilet Re-use
Disposal Type	Surface / sub-surface	Surface / sub-surface	Surface / sub-surface
Disposal Area	AS/NZS 1547 + Nutrient balance	AS/NZS 1547	Reduced AS/NZS 1547
Operator Awareness	Must be made aware	Must be made aware	Must be made aware
Robustness	Good	Unknown	Uknown

[1] Secondary treatment refers to BOD_5 < 20-30 mg/L, SS < 30 mg/L, no reference to pathogen levels is normally given. [2] Tertiary treatment refers to an effluent standard better than Secondary. This may include a range of performance criteria such as nutrient removal, additional solids removal, or superior disinfection.

COMMUNITY BASED SYSTEM

We understand that Jerberra Estate is an existing Torrens title sub-division and on this basis a community title approach to managing a common or single sewerage system is not possible (but would be possible if the site presented a 'greenfields' sub-division. On this basis, a community effluent scheme (CES) could only be implemented if the sewer were provided by Shoalhaven Water / Shoalhaven Council. Minimum components of the CES would include:

1. Installation of a gravity sewer system to each allotment.

2. Installation of a sewer pumping station (probably only 1 servicing some 25-30 lots) and rising main (say 100 – 150 m long).

3. Installation of a sewage treatment plant (STP).

4. Installation of a wet-weather detention facility (say 20 - 50 days storage or approximately 1 - 3.25 ML depending on soil types and uptake rates).

5. Installation of a reclaimed water re-use scheme redirecting reclaimed water back to residential allotments for a range of purposes (eg. garden and lawn irrigation, toilet flushing, car washing etc). Alternatively, a dedicated irrigation field could be situated on each allotment such that it received a set-volume of irrigation water each day and the home owner had no uncontrolled access to the reclaimed water.

The CES would not require any easements, but it would involve the purchase of at least 1 – 3 allotments. Given the small scale of the scheme and that there is not direct discharge to receiving waters, an EPA license may not be required (depending on Shoalhaven Water's licensing requirements). Shoalhaven Water would be responsible for operating and maintaining the scheme and design and construction would be in accordance with their standards.

A CES offers several advantages over the on-site treatment / disposal systems, including:

1. Design sewage flow rates can be based on peak populations rather than peak household occupancy as in the case of the individual allotment system. This means that the total EP for the study area would be say 153 x 3EP/dwelling. At say 145 L/EP/d, this would result in a peak daily flow rate of 66.555 KL/d. For the on-site system, the design total for the site would be 110.925 KL/d (ie. 5 EP/dwelling rather than 3 EP/dwelling for the community system).

2. A common and larger STP is capable of more consistently achieving higher effluent performance standards than typical on-site systems. This comes about because of:

    a. Cost of construction and operation reduces with scale of the STP.

    b. Operating funds can be collected from allotment owners by Council (thorugh its rating system). For example at this site, at an annual rate of say $650/year, an annual operating budget of $99,450 can be collected to safely operate and manage the STP and effluent re-use system.

3. There is only one system and therefore total site management requirements are reduced when compared to multiple on-site systems.

4. More of the site allotments are likely to be able to undertake reclaimed water re-use than under the individual allotment scheme.

5. Buffers to internal property boundaries of 3/6 m would not be required given the high quality of water and its supply from a Shoalhaven Water operated facility. This provides for greater flexibility in scheme design and location of nominated re-use areas within individual allotments.

Several issues and / or disadvantages arise in the case of the CES.

1. Allotments will need to be purchased to site the necessary infrastructure.

2. The rate at which the Estate is developed may affect the operation and performance of the STP.

3. The community within the Estate will need to be informed and educated about the schemes operational requirements.

4. Given that the majority of infrastructure will need to be constructed up-front, funding will probably need to come from Council initially and then recovered either through rating or some other mechanism.

SUMMARY RECOMMENDATIONS

1. A decision will need to be made in relation to whether individual or a communal CES system is to be pursued.

    a. In the case of the individual systems, the cost to land owners will be considerable on the smaller allotments where space restrictions require more elaborate and complex on-site sewage management scheme and non-potable re-use will be required. These system may cost the home owner $20,000 - $25000 once fully constructed. In the case of the larger allotments where more land is available, a standard AWTS and irrigation system may suffice, costing approximately $8000 per dwelling.

    b. In the case of the communal system, 1-3 lots will need to be resumed for the necessary infrastructure including the STP and the wet-weather storage system. Cost for the scheme may be of the order of $15,700 per allotment (comprising of a <u>very</u> preliminary budget of $650 K for the STP which would be for nutrient removal and tertiary filtration and dual disinfection, $150 K for the wet-weather storage facility, $1500 K for sewering and dual reticulation, and $100 K for a pump-station). The cost of resumed lots would need to be added to the above cost estimate.

2. A more detailed and precise land capability map should be produced. This will assist in isolating allotments on which various effluent management options (as per Table 2) are feasible or where effluent disposal can not be undertaken. This should account for recommended buffer distances to water courses (see

Attachment B) in accordance with the environmental Health Protection Guidelines (1998) and Shoalhaven City Council's DCP 78.

3. More detailed water / nutrient balance assessment should be developed to refine the sustainable effluent application rate nominated by Coffey's (ie. DIR = 0.67 mm/d). Our view is that a sustainable rate may be considerably higher than that recommended by Coffey's, particularly in light of the potential for higher effluent quality (with nutrient removal) available from a range of manufacturers. These assessments should be undertaken for a range of dwelling sizes (eg. 2 – 5 bedrooms).

4. Following the above, the minimum allotment size recommended by Coffey's should be revisited in the light of the various on-site treatment alternatives. Various minimum performance standards (in terms of water consumption restrictions, effluent quality requirements and re-use requirements) can then be determined for each of the existing allotments.

5. In the event that a CES is regarded as one which can pursued, then a dual reticulation system should be constructed such that reclaimed water can be returned to each allotment. A suitable location for the STP and wet-weather storage facility will need to be chosen. Our preliminary view is that this should be in the NE corner of the site, with a pump-station located in the centre-south of the site (to transfer sewage to the STP at the NE of the site). See Attachment A for preliminary location of these structures. Our preliminary view is that some 150 m^2 will need to be provided at each allotment as a designated effluent disposal area within the sites landscaping / gardens. This is made on the assumption that nutrient removal (say N = 10 mg/L and P = 2 mg/L), disinfection and tertiary filtration are provided at the communal STP and would need to be confirmed with more detailed analyses.

If you require any further information, please do not hesitate to contact the writer.

For and on behalf of

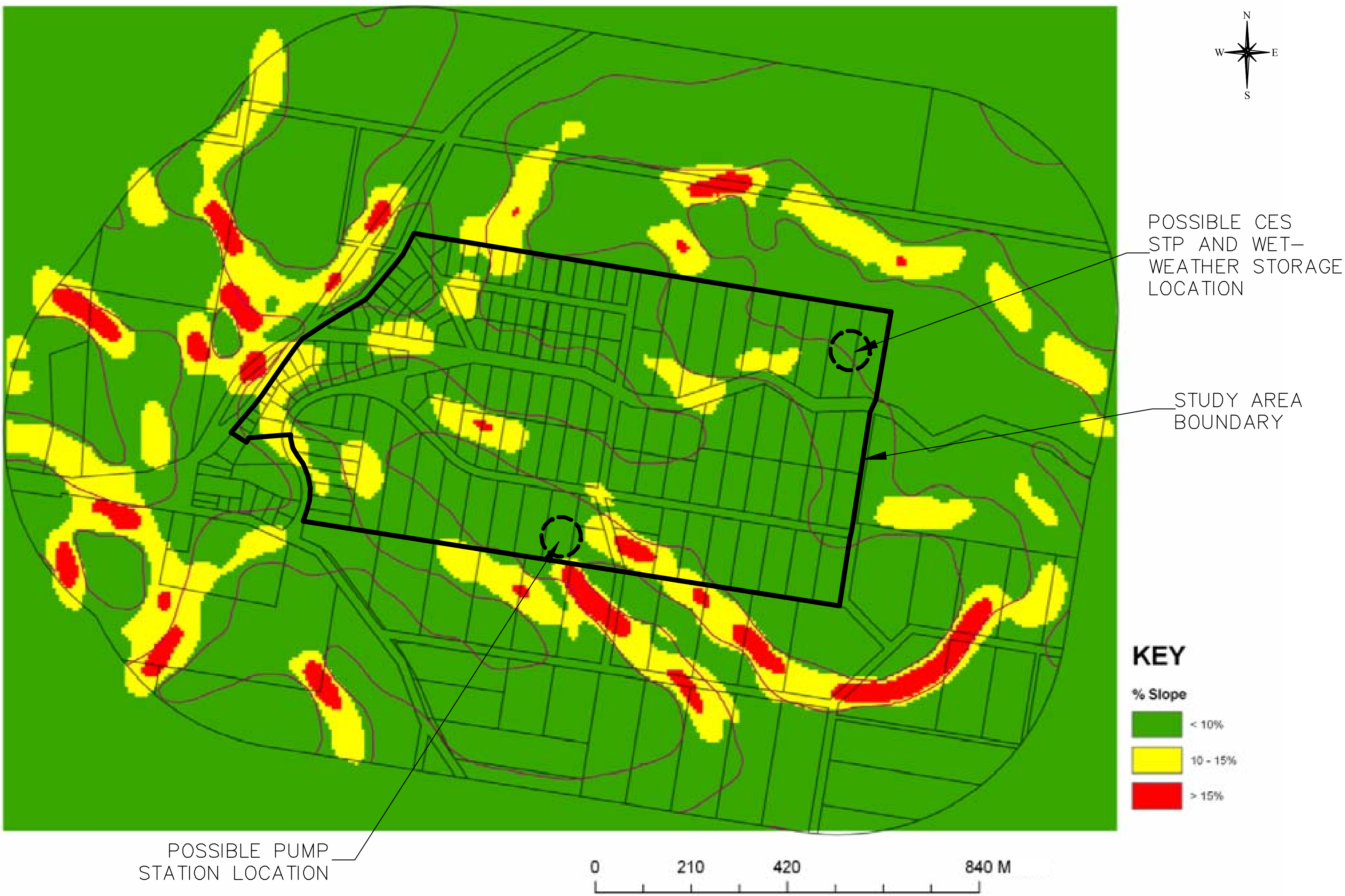
MARTENS & ASSOCIATES PTY LTD

DR DANIEL MARTENS

BSc(Hons1), MEngSc, PhD, MAWA, FIEAust, CPEng, NPER

Manager, Principal Engineer

ATTACHMENT A – JERBERRA ESTATE SLOPE MAP



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CLIENT / PROJECT: JERBERRA ESTATE WASTEWATER MANAGEMENT ASSESSMENT

JERBERRA ESTATE SLOPE MAP

THIS PLAN MUST NOT BE USED FOR CONSTRUCTION UNLESS SIGNED AS APPROVED BY PRINCIPAL CERTIFYING AUTHORITY
All measurements in mm unless otherwise specifiec.

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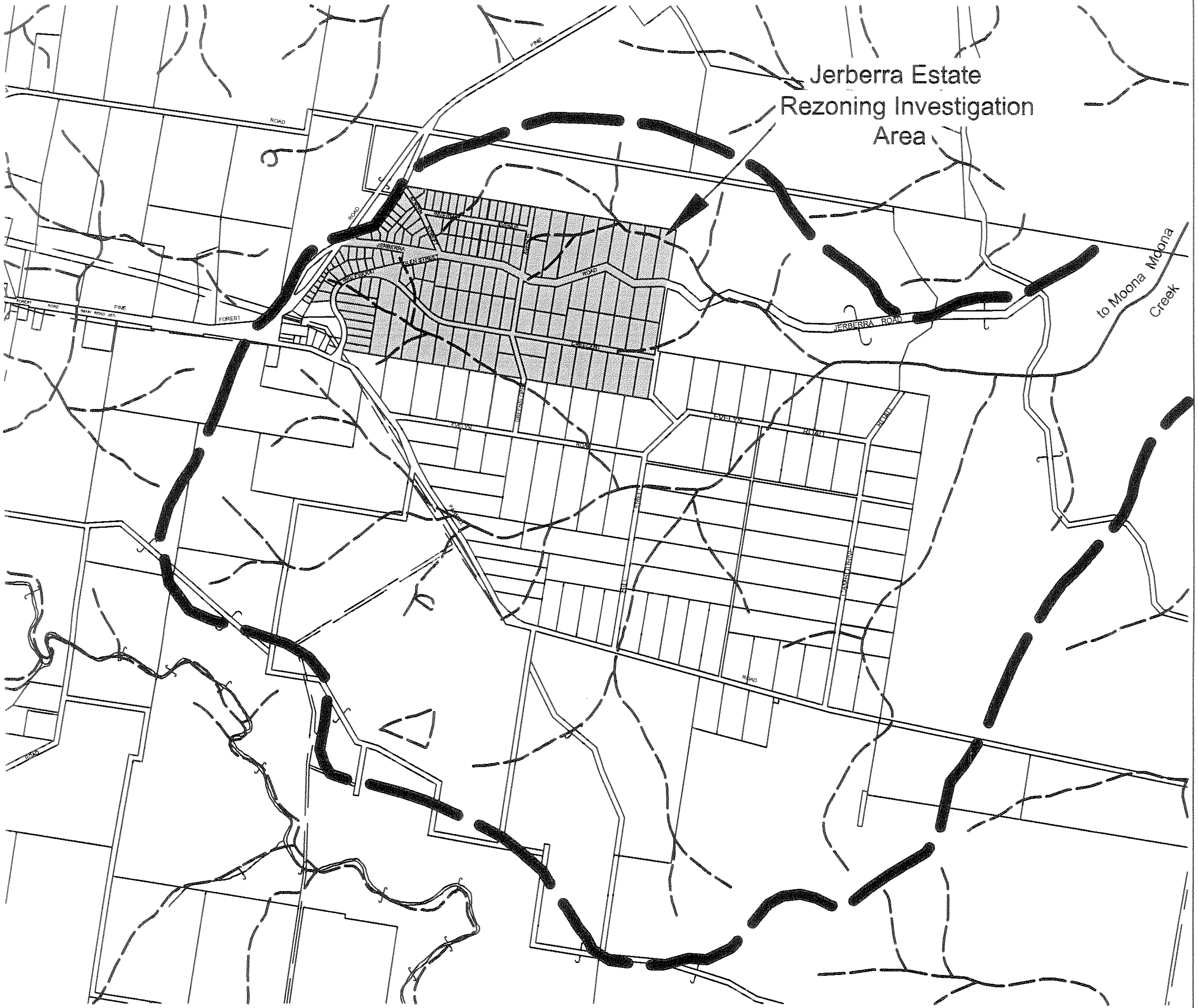
REV.	DESCRIPTION	DATE	ISSUED
1	WASTEWATER MANAGEMENT ASSESSMENT	3/11/05	JF

ATTACHMENT B – JERBERRA ESTATE CREEK MAP



Moona Moona Ck sub-catchment boundary & stream network

LEGEND

- INTERMITTENT WATERCOURSE
- PERENNIAL WATERCOUSE
- SUB-CATCHMENT BOUNDARY

Scale: 1:20000

All dimensions are in metres

Planning Group

Date: 22/11/2005

Cad File: Graphics/Projects/City/Lep/Dlep/DraftLP155/ReportMapNov2005

Shoalhaven City Council