RURAL/RESIDENTIAL SUBDIVISION – CREATING POSITIVE OUTCOMES: A CASE STUDY AT MARULAN, NSW

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Abstract

In the past ten years, rural/residential subdivisions have become increasingly common in a variety of districts across NSW. This trend continues, not only in response to developer pressure, but also the growth of rural villages and the general population push away from Sydney. Typically, requirements for effluent disposal have previously been non-specific and variable amongst Local Government Areas. In subsequent times, requirements have become more stringent and standardised. This is due to the release of not only 'On-site Sewage Management for Single Households' (Department of Local Government *et.al.*, 1998 – referred to as the 'Silver Book'), but also State Environmental Planning Policy No. 58, 1999 (SEPP 58) and AS/NZS 1547:2000 (Standards Australia and Standards New Zealand, 2000).

In response to the growth of rural areas, Mulwaree Council rezoned approximately 450 hectares of land on the western margins of Marulan village to allow provision of rural/residential allotments. The maximum allowable yield based on Council's density control provision is approximately 210 lots. The rezoned land is contained within the Wollondilly catchment.

The main constraints to on-site effluent disposal influencing the lot layout/yield are the perennial and intermittent watercourses and associated buffer distances. Climatic influences also affect requirements for effluent irrigation from an aerated wastewater treatment system (AWTS), or similar. Provision of reserve disposal areas have also been considered. Based on the site constraints, the yield of rural/residential lots is approximately 180, which range from 1.0 – 6.8 hectares.

Consent Authorities included Mulwaree Council, the Sydney Catchment Authority (SCA), the Department of Land and Water Conservation (DLWC) and Sydney Water Corporation. The approval process highlighted how working concurrently with the consent authorities provided appropriate environmental outcomes, satisfaction for the developer and standard controls regarding on-site effluent disposal for landholders.

Keywords

buffer zones, consent authorities, guidelines/standards, on-site effluent disposal, physical constraints, rural/residential subdivision.

1 Introduction

It is inevitable that the demand for rural/residential subdivision across NSW will increase and is therefore something that both consultants and consent authorities have to accept. An amenable working situation regarding approval is imperative.

Prior to implementation of the Silver Book (DLG, 1998), SEPP 58 (Department of Urban Affairs and Planning, 1999) and AS/NZS 1547:2000 (Standards Australia and Standards New Zealand, 2000), the standards for effluent disposal in rural/residential subdivisions were not as stringent as currently experienced. The choice of effluent treatment system, whilst being more limited, was relatively open-ended. Buffer distances from intermittent watercourses and stock dams were only 25 m. For perennial watercourses, a 40 m or 50 m set-back distance for effluent disposal was required. Irrigation areas were also sized on the basis of the percolation methodology from the superseded AS 1547 (Standards Australia, 1994), which provided significantly smaller irrigation areas relative to current methodologies. Furthermore, there were limited concerns regarding nutrient loadings and other pollutants in treated effluent.

A subdivision site at Marulan has been cited to show the methodology applied to the assessment in response to current standards and guidelines. Due to the size of the subdivision, careful assessment was required as a function of the potential for adverse environmental impacts. The nominated system for dwellings is the AWTS.

Careful consideration of landholders should be allowed during the approval process. For all lots, it must be assured that there is enough useable land area for both building and effluent disposal. This allows landholders to buy into an approved subdivision without facing problems regarding effluent disposal because of limitations with useable land at the construction certificate stage. Furthermore, certain controls need to be put in place (Section 88B Instrument, Covenant or similar – for example the location of building envelopes and the choice of effluent disposal system) so that landholders know what they are in for when they purchase land.

Pertinent issues for landholders should be consistent, simple and relate to the more basic matters such as the choice of system, delineation of building envelopes (i.e. where they can and cannot build), requirements for irrigation areas, the actual form of irrigation to be nominated and servicing/maintenance obligations. This provides a level of understanding and assurance prior to building.

2 Consent Authorities

Consent authorities for the subdivision site at Marulan included Mulwaree Shire Council, the SCA, the DLWC and Sydney Water Corporation. In the relatively short existence of SCA, this is the largest subdivision proposal they have encountered as the site covers an area of approximately 450 hectares. It is believed Council was supportive of rezoning and subdivision, but subsequently took a lesser role in such a large subdivision by relying more on advice from the relevant Government departments. For the subject site, the concurrence situation with SCA means that Mulwaree Shire Council is bound to follow their advice and requirements. This effectively makes the SCA the main consent authority.

The SCA will visit sites on request and provide advice regarding appropriate buffer distances from watercourses and assessment of a tentative lot layout prior to a final one being compiled. From experience, the SCA are not out to hinder development, but they aim to ensure that appropriate standards are achieved as reflected in the lot layout. Negotiations tend to come down to minor variations in the number/layout of lots and less significant aspects of the effluent disposal scheme.

Sydney Water and DLWC take similar roles to the SCA and have provided their comments on the proposal at Marulan as a whole. As with the SCA their main concerns relate to maintenance of surface and ground water quality, not only at the subject site, but also in the Wollondilly catchment. Sydney Water and DLWC sometimes provide suggestions to assist in these water quality objectives such as the construction of 'runoff dams' (with or without reeds) and earth mounds.

3 Standards & Compliance Requirements

Further to the consent authorities involved with the approval process, the relevant 'guidelines' for on-site effluent disposal are the Silver Book (DLG, 1998), SEPP 58 (DUAP, 1999) and AS/NZS 1547 (Standards Australia and Standards New Zealand, 2000). The merits of the Silver Book have been debated in many forums since its inception, and they will not be discussed here. SEPP 58 was initially controlled by the Department of Urban Affairs and Planning (DUAP), but is now administered by the SCA. Because of the 'concurrence' situation with the SCA, they took the main role in the approval process.

SEPP 58 is not prescriptive, but relates to water quality objectives that must be achieved. Whilst SEPP 58 is therefore somewhat open-ended, the SCA actually took a hands-on approach to assess requirements for effluent disposal to ensure that water quality objectives were achieved.

The new AS/NZS 1547:2000 (Standards Australia and Standards New Zealand, 2000) has provided more consistency and order with respect to site investigations and the design parameters derived. It has put the onus on the consultant to thoroughly assess subsurface characteristics with the emphasis now on soil type and structure, as distinct to the percolation tests and general textural classifications. Each soil horizon has to be assessed for a variety of factors, and design parameters applied should be based on the most limiting B horizon. The provision of soil categories in the standard allows correlation with permeability, indicative drainage class and design irrigation rate. Whilst specific details regarding trench length calculations are provided in AS/NZS 1547:2000 (Standards Australia and Standards New Zealand, 2000), the Silver Book is utilised to size irrigation areas based on water and nutrient balances.

4 Site Assessment

The site assessment involved a desk study, ground survey to delineate physical constraints, excavation of test pits and laboratory testing of representative soil samples. Prior to provision of the lot layout, the physical constraints to on-site effluent disposal were determined and all watercourses were examined on the property with the SCA. The required buffer distances were confirmed with the SCA, based on their defined characteristics of watercourses. There are also relatively small areas typically about 2000 – 4000 m^2 with localised rock outcrops that are also viewed as unusable for the purposes of effluent irrigation.

Whilst the investigation on this large site was on a reconnaissance level, it still had to be proven that all proposed Lots contain enough useable area available for building and effluent disposal. No questions can be left regarding this on a single lot due to potential difficulties for landholders and Council at the construction certificate stage. The minimum area of building envelopes was controlled by the irrigation area requirements for an expected maximum of five bedrooms in dwellings, with provision of duplicate reserve areas for possible future use. Furthermore, consideration was given to boundary setback distances and the actual area taken-up by dwellings and associated features such as a driveway, shed/garage and pavements when nominating the minimum useable area required in building envelopes.

5 Results of Investigation

5.1 Physical Constraints

The main constraints to on-site effluent disposal influencing the lot layout/yield are the perennial and intermittent watercourses and associated buffer distances. Lesser constraints include small areas of rocky outcrops and steeper land with a fall greater than 1 in 7.

During the ground survey, all watercourses were defined and suggested buffers determined by the author were then implemented prior to provision of a lot layout. Whilst watercourse buffers are greater in the Silver Book, the SCA have broadened their definition when applying set-back distance requirements.

Defining properties for intermittent watercourses include the degree of wetness in channel, steepness of sidewalls, size of upslope and downslope catchments, length, location and flow-through connection with perennial watercourses and the presence of plants indicating waterlogging. For the SCA, their overall aim of defining intermittent watercourses and providing appropriate buffer distances is to determine their extent with respect to being a possible 'conduit' for pathogens and viruses.

Whilst the Silver Book requires a 40 m buffer distance from intermittent watercourses, the SCA require a 100 m set-back distance from such features when they are well-defined. This is the same as their requirement for perennial watercourses, unless 'prescribed', where a 150 m buffer distance is normally implemented.

For the subject site, the following watercourse set-back distances were applied:

- 100 m from Joarimin Creek, that is, a perennial watercourse
- 100 m from the prominent, defined intermittent watercourses
- 40 m from stock dams and other less well-defined intermittent watercourses
- 20 m from very poorly-defined intermittent watercourses (or topographic low points)

As part of the investigation, a groundwater bore search was conducted with the DLWC. The search provided information from bores within an 8.5 km radius around the subdivision site. The search found that there were no licensed water bores on the subject site. Of the list of bores provided, only five were located relatively close to the site (within approximately 2 km). For these bores, the following information was provided; distance from the site, final depth, yield, depth of water bearing zones, geological parent material and intended purpose. Results from the search at Marulan indicate that the possible minimum depth to groundwater below the subdivision site would range from 14.0 – 30.0 m for both the granite and porphyry geological materials. This satisfies the guidelines in Table 6 of the Silver Book and represents a minor limitation.

5.2 Subsurface Profile

Geological mapping and a series of test pits excavated in areas typical of those suitable for on-site effluent disposal were utilised to assess the subsurface characteristics. The Goulburn 1:250 000 scale Soil Landscape Sheet indicated that the subdivision site is underlain by both the 'Bindook Road' and 'Garland' soil groups (Hird, 1991).

As a function of the soil groups, two bedrock types were encountered, granite and porphyry. Within the granitic terrain, two predominant soil types were delineated. These are Yellow Podzolic soils with a duplex structure and Yellow Earths with a gradational structure. The extent of the Yellow Podzolics and Yellow Earths in the granitic terrain was mapped across the site.

Within the porphyry terrain, two predominant soil types were delineated. These are Yellow Podzolics with a duplex structure and Yellow Earths with a gradational structure. Yellow Podzolics and Yellow Earths in the porphyry terrain were also mapped. Tables 1 and 2 relate to the site at Marulan and show how AS/NZS 1547 (Standards Australia and Standards New Zealand, 2000) has been applied.

Table 1: Summary of Results from Selected Test Pits

Test Pit No.	Bedrock Type	Layer Top (m)	Layer Base (m)	Horizon	Texture	Structure	Overall Structure & Type	Coarse Fragments %
1	Porphyry	0	0.1	A1	SL	SG	Duplex,	10 – 20
		0.1	0.3	A2	SCL	SG	Yellow	10 – 20
		0.3	0.6	B	MC	M/B	Podzolics	20 – 50
		0.6	0.75	C	Porphyry			10 – 20
2	Porphyry	0	0.15	A1	CS	SG	Duplex,	20 – 50
		0.15	0.5	A2	SCL	SG	Yellow	20 – 50
		0.5	0.7	B	MC	M/B	Podzolics	20 – 50
		0.7	1.3	C	Porphyry			20 – 50
3	Granite	0	0.15	A1	LS	SG	Duplex,	2 – 10
		0.15	0.35	A2	CS	SG	Yellow	2 – 10
		0.35	0.95	B	SC	MOD	Podzolics	2 – 10
		0.95	1.6	C	Granite			2 – 10
4	Granite	0	0.15	A1	CS	SG	Duplex,	10 – 20
		0.15	0.35	A2	SCL	SG	Yellow	10 – 20
		0.35	0.6	B	LMC	M/B	Podzolics	20 – 50
		0.6	0.8	C	Granite			20 – 50

LS = loamy sand, CS= clayey sand, SL = sandy loam, SCL = sandy clay loam,
SC = sandy clay, LC = light clay, LMC = light medium clay, MC = medium clay,
SG = single grained, M/B = massive/blocky and MOD = moderate.

Table 2: Relationship of Findings from Selected Test Pits to the Soil Category, Indicative Permeability Value, Indicative Drainage Class and Design Irrigation Rate

Test Pit No.	Bedrock Type	Layer Top (m)	Layer Base (m)	Texture	Soil Category	Indicative Permeability (m/day)	Indicative Drainage Class	Design Irrigation Rate (mm/week)
1	Porphyry	0	0.1	SL	2	> 3.0	WD	35
		0.1	0.3	SCL	3	1.5–3.0	MWD	28
		0.3	0.6	MC	6	<0.06	VPD	15*
		0.6	0.75	Porphyry				
2	Porphyry	0	0.15	CS	1	> 3.0	RD	35
		0.15	0.5	SCL	3	1.5–3.0	MWD	28
		0.5	0.7	MC	6	<0.06	VPD	15*
		0.7	1.3	Porphyry				
3	Granite	0	0.15	LS	1	> 3.0	RD	35
		0.15	0.35	CS	1	> 3.0	RD	35
		0.35	0.95	SC	4	0.5–1.5	ID	25*
		0.95	1.6	Granite				
4	Granite	0	0.15	CS	1	> 3.0	RD	35
		0.15	0.35	SCL	3	1.5 - 3.0	MWD	28
		0.35	0.6	LMC	5	<0.06	PD	20*
		0.6	0.8	Granite				

RD = rapidly drained, WD = well drained, MWD = moderately well drained,
ID = imperfectly drained, PD = poorly drained, VPD = very poorly drained and
* = most limiting horizon applied to any relevant calculations.

5.3 Sizing of Building Envelopes

Apart from the useable area on a given Lot, the factors controlling the size of building envelopes include the area required for effluent irrigation, provision of a duplicate reserve irrigation area, boundary setback distances and the actual area taken-up by dwellings and associated features. All lots have had their building envelopes and corresponding areas delineated. This provides further assurances for landholders when they purchase, whilst ensuring that all lots have enough useable land area.

Maximum five bedroom dwellings with a design hydraulic loading of 1500 L/day were applied to irrigation area calculations (reticulated water supply). This allows landholders scope regarding the size of a particular dwelling when they purchase because they know a Lot can cater for up to five bedrooms. For the subject site, the water and nutrient balance requirements with respect to irrigation areas are basically consistent.

Water balance calculations gave negative values for three months in the effluent applied column for May, June and July based on application of a percolation allowance of 20 mm per month and appropriate climatic data. The annual liquid loading rate, or 'H' value, was 539 mm. For the maximum design volume of 1500 L/day, an irrigation area of 1020 m^2 was required. This was doubled to 2040 m^2 to allow for reserve areas.

Provision of a minimum area of 3500 m^2 in building envelopes was nominated, thereby leaving at least approximately 1400 m^2 for the siting of a five bedroom dwelling, shed, associated features (e.g. paved areas) and provision of minimum set-back distances of 3 m or 6 m from dwellings. The building envelopes also have boundary set-back distances of 10 m already in place, which should suffice for both the siting of dwellings and irrigation areas whilst not detracting from the useable area component of lots.

5.4 Laboratory Testing

Four soil units were mapped across the site, and testing carried out on a representative sample from each of them by a National Association of Testing Authorities (NATA) Registered Laboratory. This allows given lots within a certain soil grouping to follow the relevant advice in the laboratory testing report regarding soil amelioration. Alternately, supplementary testing could be carried out at the construction certificate stage when the exact location and size of a dwelling is known on a particular lot.

Representative samples across the site were collected in areas typical of those suitable for effluent irrigation. The B horizon soils were sampled and tested because they are the most limiting with respect to on-site effluent disposal. Results from the laboratory testing indicate that the low soil pH poses a major limitation, there is a low salinity level and minor limitation, and a typically moderate limitation regarding cation exchange capacity as a function of the low to medium values.

6 Controls for On-Site Effluent Disposal

Findings from the site investigation were utilised to provide standard controls for on-site effluent disposal in the subdivision as a whole. Typically, these controls relate to the more important issues that could impact on surface and groundwater quality as required by the consent authorities. Furthermore, they should provide clear guidance for prospective owners of rural/residential lots so they can make an informed decision when purchasing land. This also makes the building approval process much easier and faster for Local Governments by avoiding conflicts with landholders.

Standard controls for landholders included the following:

- Provision of building envelopes on all lots with calculation of the corresponding areas, thereby making it clear where building and effluent disposal must occur and how much useable area a given lot has (at least exceeds 3500 m^2).
- Choice of the AWTS as a starting point for treatment with maximum final concentrations of 15 mg N/L and 10 mg P/L (i.e. re-accredited systems). Alternate systems can be considered, but the absorption trench system septic must not be utilised. Any system requires a formalised maintenance and servicing agreement.
- Prescribed irrigation area and reserve area requirements based on the number of bedrooms in a given dwelling - see Table 3.
- Subsurface dispersal lines for irrigation to address the three months in the negative water balance.
- Use of AAA-rated water limiting devices on all fixtures in dwellings to promote water conservation.

- Supplementary laboratory testing required at the construction certificate stage for pH, electrical conductivity (salinity) and dispersivity.
- Soil amelioration and establishment of an appropriate pasture grass cover in irrigation areas with removal of cuttings during and/or after mowing.

Table 3: Effluent irrigation area requirements on all Lots for dwellings having from two to five bedrooms

NUMBER OF BEDROOMS IN DWELLING	DESIGN EFFLUENT VOLUME (kL/day) *	EFFLUENT IRRIGATION AREA TO BE ESTABLISHED (m^2)	TOTAL AREA DEVOTED TO IRRIGATION INCLUDING RESERVE AREA (m^2) #
2 and 3	0.9*	610	1220
4	1.2	855	1710
5	1.5	1020	2040

* Minimum three bedroom dwellings assumed for design purposes and a reticulated water supply.

\# Reserve area only for possible future use in case of failure of a single area.

7 Role of the Consultant

As part of this paper, it is considered useful to define the role of the consultant in rural/residential subdivisions. Some points outlined below also apply to assessments of individual lots at the Construction Certificate stage:

- The main role of a Consultant is to serve the client, as this is an appropriate business manner. However, in serving a client it is important not to give false ideals about the potential of a given lot yield. The bottom line is, a consultant has to gain approval from the consent authorities for a given subdivision. If an unrealistic number of lots are proposed the follow-up work can be costly, take considerable time and lead to a reduced lot yield.
- The matters of main importance affecting a given subdivision site should be ascertained so effort is not wasted on less relevant issues. A consultant should be able to clearly identify the main constraints and issues relating to on-site effluent disposal and assist with preparation of an appropriate lot layout based on those constraints. They should also give an overall 'in-principal' effluent disposal scheme that can be related to the design of lots and applied at the construction certificate stage.
- A consultant should carry out a site investigation and gain enough supplementary information to adequately assess the pertinent issues relating to effluent disposal and a given lot layout/yield.
- A consultant should be familiar with the choices of effluent disposal system that can be considered for allotments in subdivisions. However, it is inappropriate to get involved with the specifics of treatment system design or sales if their role is to provide a geotechnical assessment for on-site effluent disposal.
- A consultant should ensure that conditions applied to effluent disposal are realistic and workable for landholders at the construction certificate stage. They should also ensure that Standards are not so onerous as to add significant undue costs and on-going problems, yet meet the principles of the policy.

8 Conclusions

The level of input from the consent authorities with respect to proposals for rural/residential subdivision is expected to continue, particularly because the expertise of the people involved will increase as developer pressure and population growth is maintained. As distinct to 5 – 10 years ago, requirements for effluent disposal have become more stringent and standardised. This has allowed a greater level of consistency and understanding for consultants, developers and consent authorities.

Due to the site constraints to effluent disposal, the final lot yield at Marulan is considerably less than that allowed on the basis of the density control provision for the rezoning. Confirming the watercourse buffer distances with the SCA allowed for provision of a lot layout/yield that supplied both the developer and consent authorities with a level of assurance during the Approval process. Furthermore, standard controls for landholders will allow them to make an informed decision when purchasing a given lot, whilst ensuring that the construction certificate process will be simplified and expedited.

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