SGD1
C/- Tattersal Lander Pty Ltd

Groundwater Monitoring Plan: Riverside, Tea Gardens, NSW

ENVIRONMENTAL

WATER

WASTEWATER

GEOTECHNICAL

CIVIL

PROJECT MANAGEMENT

P1404136JR05V02
July 2018

Limitations Statement

The sole purpose of this report and the associated services performed by Martens & Associates Pty Ltd is to provide a groundwater monitoring plan in accordance with the scope of services set out in the contract / quotation between Martens & Associates Pty Ltd and SGD1 Pty Ltd c/- Tattersall Lander Pty Ltd (hereafter known as the Client). That scope of works and services were defined by the requests of the Client, by the time and budgetary constraints imposed by the Client, and by the availability of access to the site.

Martens & Associates Pty Ltd derived the data in this report primarily from a number of sources which may include for example site inspections, correspondence regarding the proposal, examination of records in the public domain, interviews with individuals with information about the site or the project, and field explorations conducted on the dates indicated. The passage of time, manifestation of latent conditions or impacts of future events may require further examination / exploration of the site and subsequent data analyses, together with a re-evaluation of the findings, observations and conclusions expressed in this report.

In preparing this report, Martens & Associates Pty Ltd may have relied upon and presumed accurate certain information (or absence thereof) relative to the site. Except as otherwise stated in the report, Martens & Associates Pty Ltd has not attempted to verify the accuracy of completeness of any such information (including for example survey data supplied by others).

The findings, observations and conclusions expressed by Martens & Associates Pty Ltd in this report are not, and should not be considered an opinion concerning the completeness and accuracy of information supplied by others. No warranty or guarantee, whether express or implied, is made with respect to the data reported or to the findings, observations and conclusions expressed in this report. Further, such data, findings and conclusions are based solely upon site conditions, information and drawings supplied by the Client *etc*. in existence at the time of the investigation.

This report has been prepared on behalf of and for the exclusive use of the Client, and is subject to and issued in connection with the provisions of the agreement between Martens & Associates Pty Ltd and the Client. Martens & Associates Pty Ltd accepts no liability or responsibility whatsoever for or in respect of any use of or reliance upon this report by any third party.

Head Office
Suite 201, 20 George St
Hornsby, NSW 2077, Australia
ACN 070 240 890 ABN 85 070 240 890
Phone: +61-2-9476-9999
Fax: +61-2-9476-8767
Email: mail@martens.com.au
Web: www.martens.com.au

Document and Distribution Status

Author(s)	Reviewer(s)	Project Manager	Signature
G Taylor	D. Martens	G. Taylor	

Revision No.	Description	Status	Release Date	Document Location			
				Tattersall Lander P/L	SGD1		
1	DA	Final	12.06.2018	1P	1P		
2	DPI Water Amendments	Final	19.07.2018	1P	1P		
3	NRAR Amendments	Final	25.07.2018	1P	1P		

Distribution Types: F = Fax, H = hard copy, P = PDF document, E = Other electronic format. Digits indicate number of document copies.

All enquiries regarding this project are to be directed to the Project Manager.

Contents

1 Introduction

1.1 Background

Martens and Associates (MA) has prepared this groundwater monitoring plan (**GMP**) to support the proposed Riverside Development at Tea Gardens NSW.

The GMP was previously documented in MA report Integrated Water Cycle Management Strategy (IWCMS or the 'strategy')(2015) and has been updated to address a range of modifications and issues raised by NSW DPI, and to provide the GMP as a standalone document that can be used during construction.

1.2 Previous Investigations

The integrated water cycle management strategy (**IWCMS**, 2015) addressed the management of ground water and surface waters on the site in response to a long history of consultation with State and Local Government agencies and should be read in conjunction with this management plan.

The principle objective was to ensure Neutral or Beneficial Effect (**NorBE**) from the development on receiving groundwater and surface water systems to protect receiving waters and critical ecosystems including groundwater dependant ecosystems (**GDEs**). Overall water cycle management focused on the use of 'at source' (i.e. 'distributed') stormwater treatment measures allowing preservation (to the extent possible) of existing ground water recharge mechanisms and surface water hydrology, such that there would be no significant impact on receiving waters and adjoining GDEs.

The groundwater assessment quantified existing groundwater conditions and potential hydrologic and water quality impacts on adjacent SEPP 14 wetlands. A conceptual groundwater management plan was prepared to outline potential risks resulting from the development on the aquifer and risk management methodology. Outcomes from the groundwater assessment concluded that the proposed development will result in:

1. No discernible impact from the proposed development on SEPP 14 wetland groundwater levels and water budgets

2. No discernible impact on water quality and levels in existing brackish lake (J Lake)

3. NorBE on groundwater resources for the site and surrounding areas.

4. Largely unchanged groundwater regime from existing conditions. This is due to the distributed WSUD approach to water quality management and recharge where possible in the catchment.

1.3 Site Description

The Riverside at Tea Gardens site is bounded by Myall River to the east and Myall Road to the west. The Shearwater Residential Estate lies to the north of the site and residential development of Tea Gardens is to the south. The site has an approximately one kilometre frontage to Myall Road and two kilometre frontage to the Myall River. State Environmental Planning Policy No. 14 – Coastal Wetlands (SEPP 14) historically applied to wetlands within a portion of the eastern boundary of the site adjacent to the Myall River. These wetlands have been clearly identified along with a buffer to the wetlands and zoned accordingly when the site was rezoned in 2000. The remainder of the site is available for urban development and zoned accordingly.

The site is flat with generally sandy soils. There is a slight fall to the south east. The site ranges in height from approximately 0.6m Australian Height Datum (**m AHD**) (along the foreshore of the Myall River) to 20m AHD (at the northern end of the site adjacent to Shearwater Estate). However, most of the site varies in height from between 1.6m AHD to 5.0m AHD.

The majority of the site was previously used for a pine plantation and has been substantially cleared of native vegetation. Some scattered isolated occurrences of both pines and natives currently exist on the site. The current land use on the site is cattle grazing.

1.4 Project Description

We understand that development approval is sought for the following key elements:

1. Site subdivision into 725 small to medium residential lots, carried out in 16 stages.

2. Site cutting and filling to achieve final levels of between 2.4 m and 5 m above Australian Height Datum (AHD).

3. Construction of internal road and buried services networks.

4. Creation of areas dedicated to open space, public recreation and stormwater management corridors.

5. Creation of a future commercial area.

Refer staging plans prepared by Tattersall Lander (TL) for further details.

2 Groundwater Monitoring Plan

2.1 Monitoring Elements

Key surface/groundwater elements to be monitored include:

1. Groundwater quality and levels at the adjacent SEPP 14 wetlands.
2. Groundwater quality and levels at the nearby J lake.

2.2 Monitoring Locations

To monitor water quality and levels at the J lake, location 'Lake 26' (or suitable alternative if this location cannot be found) is to be monitored.

To monitor groundwater quality and levels at the adjacent SEPP 14 wetlands, GMB3 and GMB6 are to be monitored. Refer to Attachment A for monitoring locations.

2.3 Monitoring Frequency

Groundwater level should be monitored at monthly intervals, or preferably continuously via data logger at the Lake 26, GMB3 and GMB6 sites.

Groundwater quality should be sampled quarterly at the Lake 26, GMB3 and GMB6 sites, and submitted to a NATA accredited laboratory for analysis as outlined in Section 2.4.

2.4 Water Quality Analysis

Groundwater samples should be analysed for the following parameters in general accordance with ANZECC 2000 guidelines:

1. Total Nitrogen
2. Total Phosphorus
3. pH
4. EC
5. Oxidised Nitrogen
6. Soluble reactive Phosphate
7. Cyanobacteria

2.5 Bore-field Maintenance

As part of routine monitoring events, Lake 26, GMB3 and GMB6 are to be maintained to ensure that collected surface/groundwater samples are representative.

During a routine maintenance, the following works should be completed at each bore:

1. Visual inspection and purging the bore until such time as water quality being pumped is uniform.

2. Bores found to be damaged, lost or vandalised are to be replaced.

3. Bores with an excessive algal matt build up are to be remediated with chlorine flushing and pumping, or if this is ineffective, replaced.

Where possible, we recommend all site GMBs are kept in-tact until construction processes require their removal. In the event that routine monitoring locations are required to be expanded beyond Lake 26, GMB3 and GMB6, this will broaden the selection pool of potential GMBs.

2.6 Interim Trigger Values

Interim trigger values are provided for surface/groundwater levels and quality in Table 1 and Table 2 respectively. Trigger values were generally derived based on mean background data and a reduction of two standard deviations (groundwater levels), or addition (subtraction for pH) of two standard deviations (groundwater quality). For the Lake 26 level trigger value, the value was derived from the minimum level monitored by data logger between 04.06.2009 and 06.07.2009.

Trigger values should be confirmed prior to commencement of construction works if any additional site surface/groundwater monitoring data not available at the time of preparing this report is acquired.

We note that nominated trigger values are based on minimal sampling events, and are statistically based. The trigger values are not considered to necessarily reflect unprecedented background values. Therefore, whilst exceedance of trigger values should incite some form of assessment, it is possible that certain trigger values will be exceeded as a result of natural variability. This is especially the case for TP at GMB3 and GMB6, where every background value was below the laboratory practical quantification limit (PQL) of 0.05 mg/L. As site data increases, it is envisaged that the interim trigger values may need to be modified, particularly the GMB3 and GMB6 TP trigger value.

Table 1: Interim surface/groundwater level trigger values.

Interim Surface/Groundwater Level Trigger Values (mAHD)	
Lake 26	**GMB3 and GMB6**
0.63 [1]	0.19 [2]

Notes:

1. Trigger value represents minimum level monitored by data logger between 04.06.2009 and 06.07.2009.
2. Calculated based on mean of GMB3 and GMB6 values in Attachment 6B less 2 standard deviation values.

Table 2: Interim surface/groundwater quality trigger values.

	Interim Surface/Groundwater Quality Trigger Value [1]			
Location	**pH**	**EC (µS/cm)[4]**	**TN (mg/L)**	**TP (mg/L)**
GMB3 and GMB6 (wetland) [2]	5.4	30,445	2.79	0.05
'Lake 26' (J lake) [3]	5.8	27,288	1.04	0.09

Notes:

1. Refer to Section 2.6 for determination of trigger values.
2. Calculated based on mean value in Attachment 6C for GMB3 and GMB6 plus (minus for pH) two standard deviation values.
3. Calculated based on: mean value in Attachment 6C for 'Lake 26' and 'Lake' plus (minus for pH) two standard deviation values; limited data; and a pH range of 5-8.
4. Calculated based on mean + 2 standard deviation values using existing pre-development data. These values represent the neutral data range based on monitoring to 2015.

Trigger values are to be assessed and revised during collection of long term data with Council, OEH and NSW Natural Resource Access Regulator (NRAR).

2.7 Action Requirements

Action will be required if trigger values are exceeded, or in case of pH and groundwater levels, fall below. Action will involve the following:

1. Engage a suitably qualified professional to provide advice.
2. Review the data in light of environmental/climate conditions.
3. Determine if further investigation is warranted.
4. Spatially identify key areas requiring action.

5. Determine appropriate action based on circumstances in consultation with Council, OEH and NRAR.

6. Undertake action.

2.8 Reporting

All monitoring data is to be graphed and assessed against ANZECC guidelines and presented in an annual report that will be forwarded to Council, OEH and NRAR. Council and NSW Office of Environment and Heritage and the Environment Protection Authority are to be notified if results above trigger values are found.

The need to continue the groundwater monitoring is to be assessed at the time of annual reporting. At a minimum, it is envisaged that monitoring will be required until at least 2 years following the completion of Stages 1 – 5.

All action requirements and/or changes in the GMP should be undertaken in consultation with Council, OEH and NRAR.

A detailed groundwater monitoring plan should be prepared during the detailed design phase of the development and correspond to the staged development.

3 References

ANZECC (2000), National Water Quality Management Strategy. *Australian Guidelines for Urban Stormwater Management.*

BMT WBM (2012), *Review of Water Quality Management for the Proposed Riverside at Tea Gardens Development; Final Report*.

Bureau of Meteorology (2001), *Climatic Atlas of Australia – Evapotranspiration*.

Cardno (2011), *Riverside at Tea Gardens, Integrated Water Cycle Management Strategy and Sewerage Servicing, Final, November*.

Coffey Partners International (February, 1996), *Myall Quays Development Groundwater and Surface Water Study.*

Coffey Geotechnics (October, 2007), *Groundwater Assessment Riverside Development, Tea Gardens.*

ERM (November, 2012), Riverside at Tea Gardens Preferred Project Report.

Great Lakes Council (2014), *Development Control Plan*

Landcom (2004), *Soils and Construction 'Managing Urban Stormwater'*.

Martens & Associates (December, 2011), *Preliminary Hydrogeological Study and Concept Groundwater Management Plan, Riverside, Tea Gardens, NSW.*

Martens & Associates (October, 2015), *Concept Integrated Water Cycle Management Strategy (Revised) Riverside, Tea Gardens, NSW.*

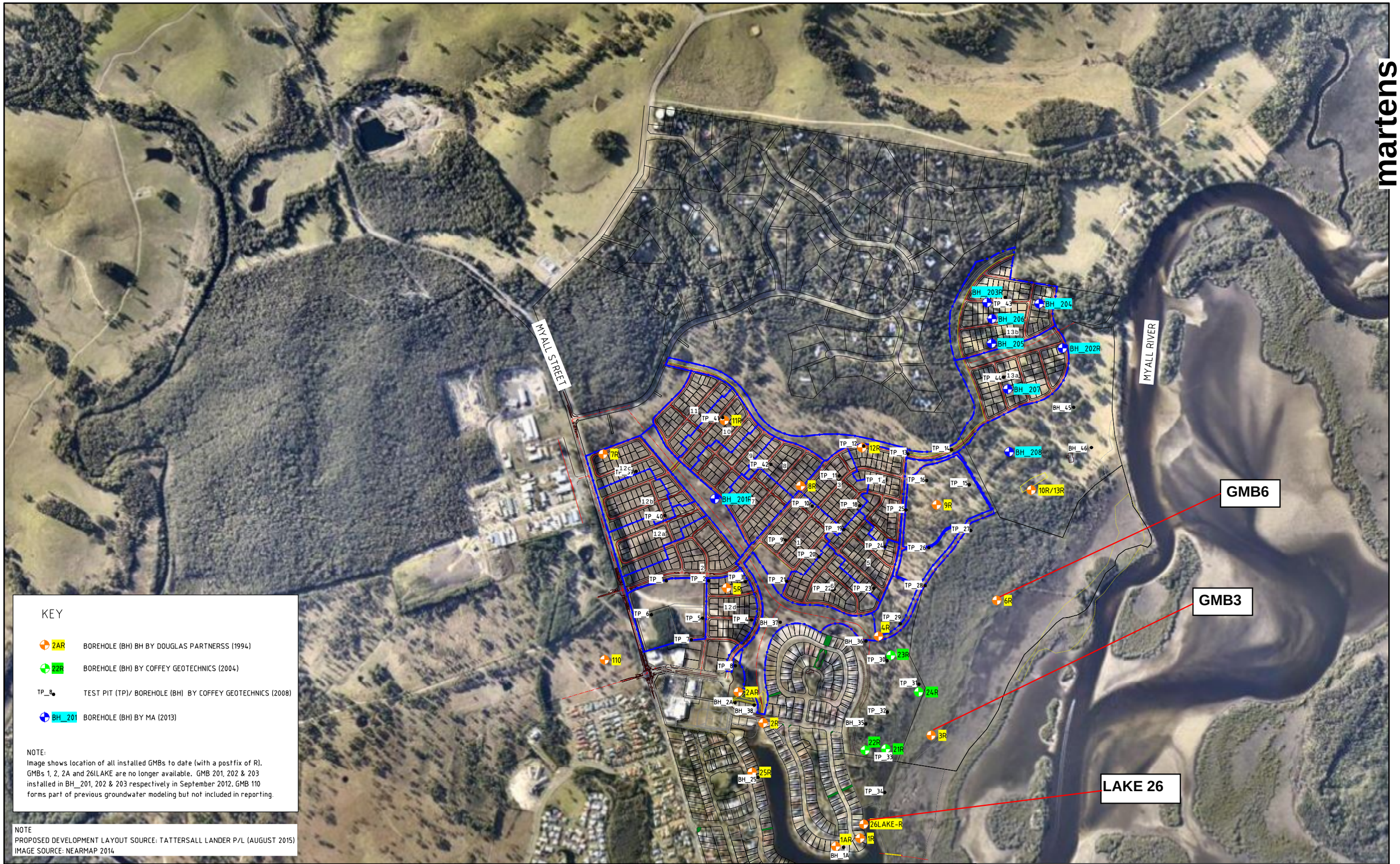
Murphy, C. L. (1995), *Soil Landscapes of the Port Stephens 1:100 000 Sheet*, Soil Conservation Service of NSW.

NHMRC (2004), *Australian Drinking Water Guidelines.*

NSW DECCW (2009), *Sea Level Rise Policy Statement.*

Sydney Metropolitan Catchment Management Authority (SMCMA) (2010), *Draft NSW MUSIC Modelling Guidelines.*

4 Attachment A – Groundwater Monitoring Testing Location Plan



KEY

2AR	BOREHOLE (BH) BH BY DOUGLAS PARTNERSS (1994)
22R	BOREHOLE (BH) BY COFFEY GEOTECHNICS (2004)
TP_8	TEST PIT (TP)/ BOREHOLE (BH) BY COFFEY GEOTECHNICS (2008)
BH_201	BOREHOLE (BH) BY MA (2013)

NOTE:
Image shows location of all installed GMBs to date (with a postfix of R). GMBs 1, 2, 2A and 26LAKE are no longer available. GMB 201, 202 & 203 installed in BH_201, 202 & 203 respectively in September 2012. GMB 110 forms part of previous groundwater modeling but not included in reporting.

NOTE
PROPOSED DEVELOPMENT LAYOUT SOURCE: TATTERSALL LANDER P/L (AUGUST 2015)
IMAGE SOURCE: NEARMAP 2014

PAGE BAR SCALE
0 100 200 300 400 500
UNITS – METRES

N
W E
S

Martens & Associates Pty Ltd ABN 85 070 240 890		**Environment | Water | Wastewater | Geotechnical | Civil | Management**	
Drawn:	KT	**BOREHOLE, TEST PIT AND GROUNDWATER MONITORING BORE LOCATION PLAN: RIVERSIDE ESTATE, TEA GARDENS, NSW**	Drawing No./ID: **Figure 3**
Approved:	RE		
Date:	07.09.2015		
Scale @ A3:	1:12000	Suite 201, 20 George St, Hornsby, NSW 2077 Australia Phone: (02) 9476 9999 Fax: (02) 9476 8767 Email: mail@martens.com.au Internet: http://www.martens.com.au	Project: P1404136 | File: JD02V01 | Revision: A