Douglas Partners
Geotechnics • Environment • Groundwater

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Project 71476.02
6 September 2010
STE:ste

Lipman Properties Pty Ltd
Level 6, 66 Berry Street
NORTH SYDNEY NSW 2060

Attention : Wal Richardson

Dear Sirs,

SUPPLEMENTARY COMMENT ON GROUNDWATER ISSUES
PROPOSED RESIDENTIAL DEVELOPMENT
120 – 128 HERRING ROAD, MACQUARIE PARK

1.0 Introduction

Following our geotechnical report dated 22 December 2009, this letter serves to clarify previous comments and to provide further comment on the expected groundwater conditions on the site of the proposed residential development at 120 – 128 Herring Road, Macquarie Park. In particular, this letter addresses comments by the NSW Office of Water (NOW), in a letter dated 7 July 2010 (Ref ER20938) and provides further comment on requirements for a drained basement.

It is understood that the proposed development will include the staged construction of five residential unit blocks (Buildings A to E). The buildings will have two to three levels of basement carparking, including a linked basement below Buildings A to D. The lowest basement level in each building ranges from RL56.6 to RL51.3 m relative to Australian Height Datum (AHD). Excavation for the basements will be required to depths of approximately 8 m to 9 m.

2.0 Results of Investigation

Douglas Partners Pty Ltd (DP) previously carried out a geotechnical investigation and prepared a report (Project 71476, dated 22 December 2009) for the proposed development on the site. The investigation included eight diamond cored boreholes to depths of approximately 12 m and the installation of two groundwater monitoring wells. The water levels were measured shortly after the investigation on 17 December 2010 and were recently measured on 23 July 2010. A summary of the measured depths to water within the monitoring wells is provided in Table 1.

Table 1 – Summary of Measured Water Levels in Monitoring Wells

Date	Depth (and RL) to Groundwater	
	BH 2	BH 8
17 December 2010	7.2 (RL51.7)	5.0 (RL59.9)
23 July 2010	6.2 (RL52.7)	5.3 (RL59.6)

Note : RL is relative to AHD

This measured water level appears to fall in 'parallel' with the general surface slope and falls towards the north at approximately 2 to 3 degrees. The measured water levels are probably associated with perched seepage flows near the interface of residual clay and bedrock and also minor seepage through fractures and joints in the rock. The water levels and seepage flows are likely to fluctuate with climatic conditions and would be expected to rise following periods of extended wet weather and to fall during periods of dry weather. It is noted that the recent measurements followed periods of wet weather in Sydney during June and July.

A groundwater bore search of the NOW website database was conducted. Within a 1.5 km radius of the site there are three registered bores to the north-east of the site (used for monitoring purposes) and two registered bores to the west of the site (used for irrigation and recreational purposes). The two bores used for irrigation and recreational purposes were installed to depths of 67 m and 81 m and are located more than 500 m away from the site.

3.0 Comments

Attachment A of the NOW letter states that "if the basement excavation intercepts or uses groundwater a license under Part 5 of the Water Act 1912 may be required from the NSW Office of Water". Attachment B of the NOW letter then provides a list of conditions that must be satisfied in order to obtain the license for the purpose of temporary dewatering. Items 1 and 2 of the specific conditions in Attachment B indicate that the design and construction of the basement structure must preclude the need for permanent dewatering and that the basement structure that may be impacted by any water table must include a water proof retention system (i.e. fully tanked structure). The issues associated with "groundwater" and "dewatering" vary significantly between sites underlain by sandy soils with high permeability and sites underlain by clay and rock with relatively low permeability. Across Sydney, drained basements are commonly adopted on elevated sites underlain by clay and rock profiles. The seepage flows are collected and disposed of intermittently over the life of the basement.

Groundwater in a broad sense is all water that occurs below the land surface, however, in terms of groundwater management only part of the water profile contains the resource known as "groundwater". An aquifer is a geological formation (either soil or rock) that can store and transmit groundwater in useable quantities such that water can be extracted economically. These aquifers generally occur within alluvial and coastal sand deposits or porous and fractured rocks. Perched aquifers are a type of aquifer of generally limited extent that occur where an impermeable layer prevents the downward infiltration of groundwater. It is expected that the measured water levels on this site are probably associated with perched seepage flows near the interface of residual clay and bedrock. Perched aquifers are generally of minor importance with regard to groundwater management and do not ordinarily retain significant quantities of groundwater in storage *(Groundwater Management Handbook, Sydney Coastal Councils Group Inc, 2006)*.

Based on our experience with previous similar projects, it is our understanding that the comments from NOW are generally targeted at sites that require temporary dewatering to lower and control the groundwater table. This temporary dewatering is generally required to allow construction of a tanked basement on low lying, relatively level sites, with deep permeable soils and a shallow permanent groundwater table (i.e. basements extending into unconfined aquifers). This site, however, is located on gentle sloping ground at an elevation of approximately RL56 - 58 m AHD and is underlain by stiff clay soil and rock with relatively low permeability. Seepage inflows along the rock surface and through the rock mass would be significantly less than groundwater inflows from a permanent groundwater table in say, highly permeable sandy soils. Seepage along the rock surface would be expected to vary with weather and is probably relatively minor during periods of dry weather, with seepage flows temporarily increasing during periods of wet weather.

For this site, groundwater seepage during construction and in the long-term should be readily controlled by "sump-and-intermittent pump" systems within a drained basement. A preliminary estimate of groundwater seepage within the basement for the entire site (i.e. for Buildings A to E) has been carried out based on seepage through rock exposed in the side walls below the measured borehole water levels. We have assumed an exposed rock surface of 950 m^2, with an average coefficient of permeability of 1×10^{-7} m/s for the rock. Based on the above assumptions, it is anticipated that up to 0.1 litre/sec (or 8000 litres/day) of seepage could be expected within the excavation. Lower seepage volumes could probably be expected during periods of dry weather.

It is understood that a drained basement is the preferred option for the development. As indicated in Section 8.2.3 of the previous DP geotechnical report, it is anticipated that groundwater seepage should be readily controlled by perimeter drains connected to a "sump-and-intermittent pump" system which is used to collect seepage for disposal via the stormwater drainage system. This type of system does not involve pumping to extract groundwater or lowering of a permanent water table. A watertight, tanked basement would avoid the need for control of seepage flows in the long-term but is considerably more expensive than the drained basement and is probably not warranted for this site.

It would be prudent to monitor the seepage flows during the excavation works to confirm and/or re-assess the proposed sump and pump system capacity and to assess water quality. Pressure grout injection techniques could be used in areas where higher flows occur, if encountered, to reduce inflow rates. Alternatively a relatively impermeable shoring wall comprising soldier piles and shotcrete infill panels could be installed and designed to withstand the hydrostatic pressures. This type of shoring system would create a barrier to horizontal seepage flows into the basement and should significantly reduce seepage flows.

4.0 Conclusion

It is considered that the temporary or long-term collection and disposal of seepage associated with a drained basement should be possible on this site and should not have a significant impact on groundwater flows or licensed groundwater users surrounding the site.

We consider that a Temporary Dewatering Licence under Part V of the Water Act 1912 is not necessarily applicable for this site and the proposed development, which will involve management of perched seepage flows. It will be necessary, however, to obtain approval from Council or the relevant consent authority prior to disposal of the collected seepage to the stormwater system or creek. If a Temporary Dewatering License is still deemed necessary by NOW then we suggest that the requirement for a tanked basement (i.e. specific conditions 1 and 2 of Attachment B) should be removed as this is essentially a commercial decision to be made by the developer when assessing management and maintenance requirements for the basement structure.

We trust the above satisfies your present requirements. Please contact the undersigned if you have any further questions or wish to discuss these issues further.

Yours faithfully
DOUGLAS PARTNERS PTY LTD

Reviewed By

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Senior Associate

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