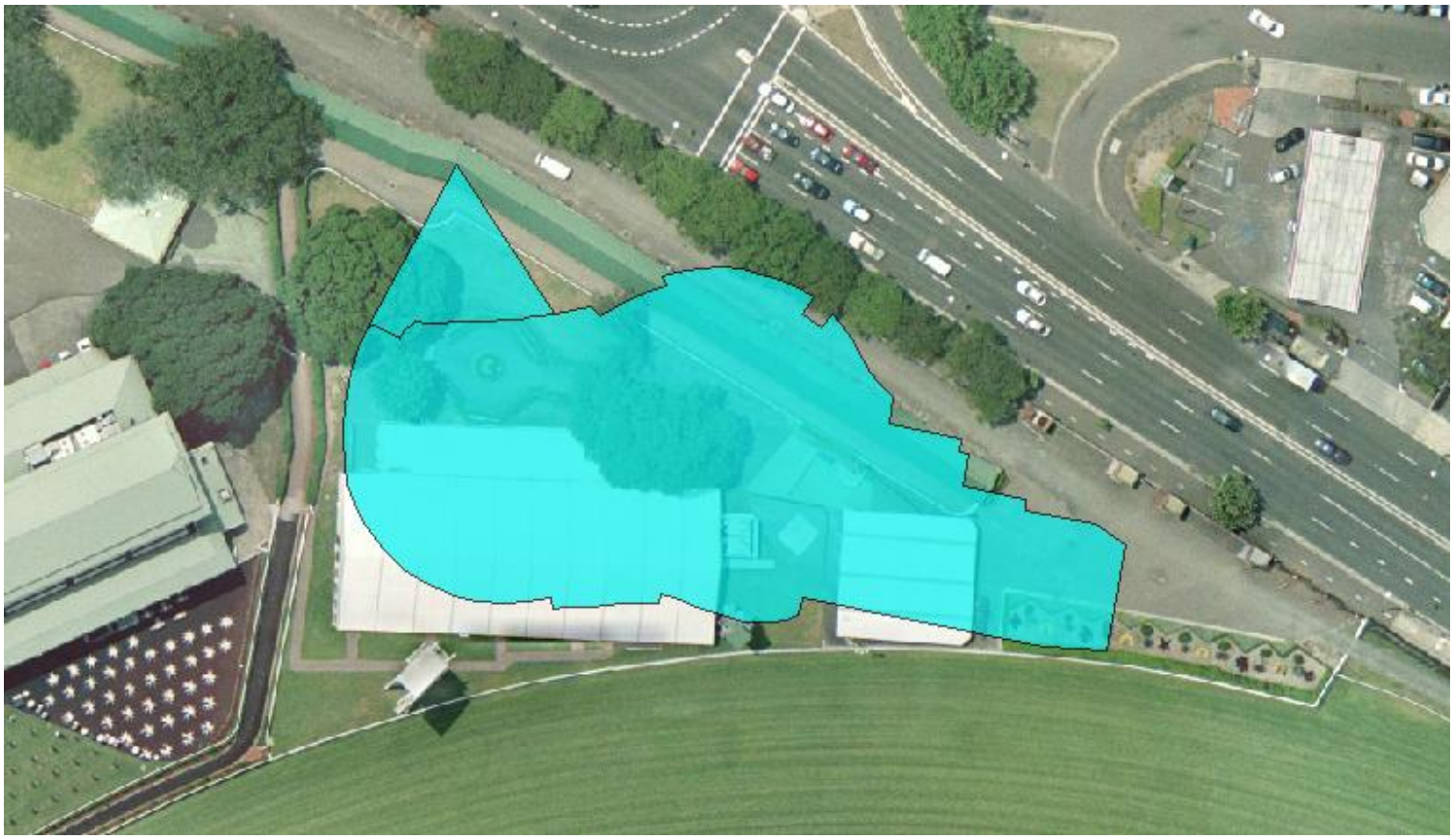
AUSTRALIAN TURF CLUB

FLOOD IMPACT ASSESSMENT

PROPOSED HOTEL



August 2013

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Project **FLOOD IMPACT ASSESSMENT ROYAL RANDWICK RACECOURSE PROPOSED HOTEL**	**Project Number** **113051**
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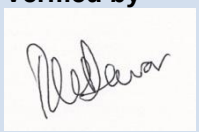
Date 2 August 2013	**Verified by** 

Revision	Description	Date
1	Draft Report	2 August 2013

FLOOD IMPACT ASSESSMENT
ROYAL RANDWICK RACE COURSE
PROPOSED HOTEL

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1. EXECUTIVE SUMMARY

1.1. Relevant DGRs

This flood impact assessment report has been prepared in order to address the flooding objectives provided in the Director General's Environmental Assessment Requirements (DGR) in relation to the construction and ongoing operation of the proposed hotel on the northern side of the Royal Randwick Racecourse. The DGR includes addressing the relevant planning provisions, goals and strategic planning objectives of the NSW Floodplain Development Manual April 2005 and the Royal Randwick Racecourse DCP 2007 (DGR #2). More specifically it notes (DGR #10) that:

The EIS shall address drainage/flooding issues associated with the development/site, including stormwater, drainage infrastructure and the incorporation of water sensitive urban design measures. The EIS shall identify any necessary water management measures.

The scope of this report is limited to the assessment of the likely impacts of the proposed development on flooding. Other flood related stormwater or water sensitive urban design tasks in DGR # 10 are addressed in separate reports. Randwick City Council's letter of 17th April 2012 notes the following regarding flooding.

6. Flooding and drainage

A detailed analysis of existing and proposed overland flow paths within the development site must be provided with any application for the proposed hotel. The application must minimise any potential adverse impact of the development on properties / infrastructure upstream and downstream of the development site and adjacent to the development site. The proposal should also minimise any potential impact on structures within the racecourse and this should be fully demonstrated in the EIS.

The DGR's should require a stormwater management plan or flood study indicating whether or not the proposed development will be below the 1 in 100 year flood level and ensuring the protection of openings and basement levels.

The subject development site is located in an area that is covered by Council's onsite stormwater detention policy. Stormwater discharge from the development site must not exceed that which would occur from a 1 in 10 year storm of 1 hour duration for the existing site conditions. All other stormwater run-off from the above site for all storms up to the 1 in 20 year storm is to be retained on the site for gradual release to the receiving drainage system as required by Council. Provision is to be made for satisfactory overland flow should a storm in excess of the above parameters occur. Sufficient information should be provided to assess compliance with Council's onsite stormwater detention policy.

This report only responds to the issues raised in the first paragraph of the above. Responses to the second and third paragraph are addressed in separate reports.

1.2. Proposed Works

The proposed works include:

- The removal of existing marque buildings;

- The removal of the dwarf wall/fence to the north of the site;
- Construction of a hotel including a cantilevered second floor;
- A basement car park with associated entrance works; and
- Minor changes to the heritage brick wall.

The proposed works have the potential to increase flood levels by restricting flow paths and/or reducing the temporary floodplain storage capacity and as such necessitate a flood impact assessment.

1.3. Certification

WMAwater's task was to assess the potential impacts on flooding (levels, velocity and flows) of construction of the proposed hotel within the grounds of Royal Randwick Racecourse. All other aspects relating to flooding and stormwater drainage have been addressed in separate studies.

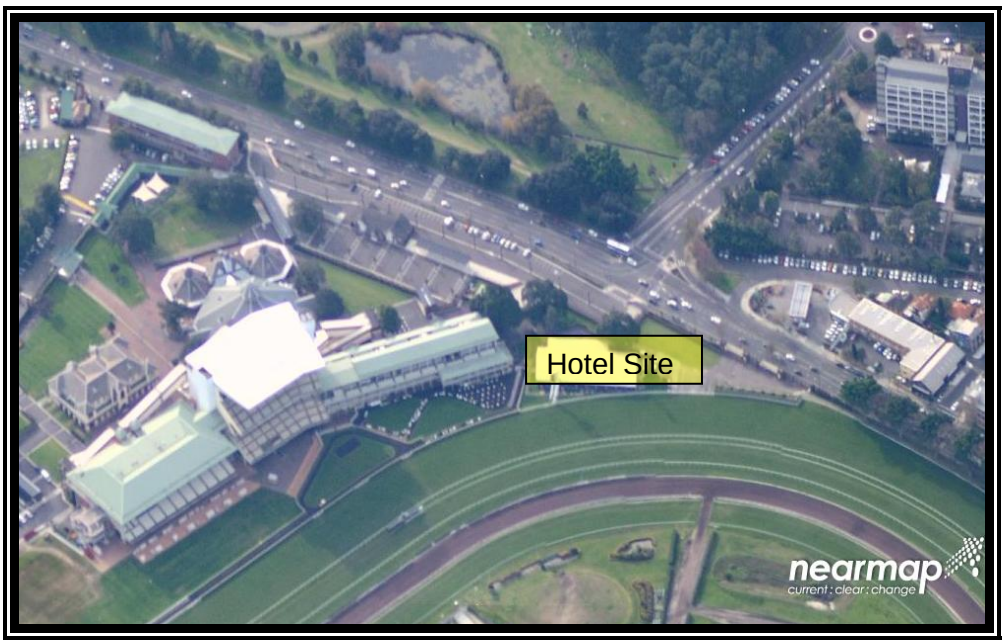
WMAwater confirms that this report certifies that the proposed hotel works as described in Figure 3 of this report will have no significant impact (< 0.01m) in the 100 year Average Recurrence Interval (ARI) flood event on lands outside Royal Randwick Racecourse. As such the construction is in accordance with the principles of the NSW Floodplain Development Manual April 2005 and the Royal Randwick Racecourse DCP 2007.

2. INTRODUCTION

2.1. Current Proposal

Royal Randwick Racecourse is located between Alison Road to the north, Wansey Road to the east, High Street to the south and residential properties along Doncaster Road to the west (Figure 1 and Figure 2). The grounds are part of the South Sydney – Centennial Park catchment (SS – CP). A significant feature of the site is that it overlies the Botany Aquifer in a locality where recharge of the aquifer occurs and where groundwater quality is typically good. Development and upgrades within any part of the racecourse site are covered by development controls as set out in the Royal Randwick Racecourse Development Control Plan, 2007.

Application for development within the site including works to construct a hotel has been made to the NSW Department of Planning (refer to Oct 2011 photograph below – courtesy of nearmap).



This present hydraulic assessment report has been prepared to address the flooding objectives provided in the Director General's Environmental Assessment Requirements (DGR) for the construction and ongoing operation of the proposed hotel (DGR #2 and #10). The DGR includes addressing the relevant planning provisions, goals and strategic planning objectives of the NSW Floodplain Development Manual April 2005 and the Royal Randwick Racecourse DCP 2007 (DGR #2). More specifically it notes that (DGR #10):

The EIS shall address drainage/flooding issues associated with the development/site, including stormwater, drainage infrastructure and the incorporation of water sensitive urban design measures. The EIS shall identify any necessary water management measures.

Proposed works (summarised in Figure 3) have the potential to increase flood levels by restricting flow paths and/or reducing the temporary floodplain storage capacity and as such

necessitate a flood impact assessment.

The proposed works include:

- The removal of existing marque buildings;
- The removal of the fence to the north of the site;
- Construction of a hotel including a cantilevered second floor;
- A basement car park with associated entrance works; and
- Minor changes to the heritage brick wall.

This report assesses the likely impacts of the proposed development on flooding. Other flood related stormwater or water sensitive urban design tasks are addressed in separate reports.

2.2. History of Development at Royal Randwick Racecourse

WMAwater's November 2008 report *"STORMWATER MANAGEMENT PLAN PART 3A SUBMISSION FOR ROYAL RANDWICK RACECOURSE Stage 1 Works - 2008 Upgrade High Street Connection, Oaks Drive, Day Stalls, Removal of Midfield Ponds"* provides an assessment of the following works:

- The construction of new taxiway, with access from Ascot Street;
- The upgrading of the access road from Oaks Drive to High Street (to be known as the High Street connection);
- The relocation of the existing day stalls to the grassed area south of the spectator precinct (known as the Leger Lawn); and
- Infilling of three ornamental ponds in the midfield area opposite the main stand (already undertaken as part of the World Youth Day works).

WMAwater's April 2009 report *"STORMWATER MANAGEMENT PLAN PART 3A SUBMISSION FOR ROYAL RANDWICK RACECOURSE Stage 4 Works – 2009 Upgrade, Alison Road Works"* provides an assessment of the spectator and vehicular entrance works along Alison Road.

WMAwater's November 2011 report *"HYDRAULIC ASSESSMENT Stage 5 Works – Spectator Precinct Works"* provides an assessment of the impacts of construction of works in the spectator precinct area.

2.3. Previous Flood Studies

WMAwater have been previously engaged by Randwick City Council to undertake a comprehensive Flood Study for the Centennial Park catchment (South Sydney – Centennial Park Flood Study). Initially, an integrated 1D/2D SOBEK hydraulic model was established, calibrated to historical flood data and used for design flood estimation. This study was subsequently modified and the 1D/2D SOBEK hydraulic model was replaced with a 1D/2D TUFLOW hydraulic model. The impetus for the replacement was the inclusion of further topographic detail in the hydraulic model and the extension of the study area upstream of

Centennial Park. The TUFLOW model offers more flexibility in its modelling approach and furthermore is more widely used in Australia.

With permission from Randwick City Council, data, models and results from the South Sydney-Centennial Park TUFLOW Flood Study are used as a basis for this impact assessment. All inflows, ground levels and assumptions used in this present study are compatible with the approach adopted for the Flood Study.

3. FLOOD BEHAVIOUR AND FLOOD MODELLING

3.1. Overview of the Catchment

Royal Randwick Racecourse lies within the SS – CP catchment (Figure 1). The catchment spans parts of three local government areas; Randwick City Council, City of Sydney and Waverley Council.

Flooding within Royal Randwick Racecourse occurs due to rainfall over the site itself and from three main external catchment flows (Figure 2):

- Flows along Alison Road;
- Flows surcharging from the Centennial Park basin and passing through the northwest section of the racecourse site concentrated between Gate 1 and Doncaster Avenue; and
- Overflow from the 1200 m chute basin.

Catchments contributing to these flows are discussed below. Note: the naming system used to describe these sub-catchments is consistent with Randwick City Council's stormwater asset register system.

3.1.1. Centennial Park South Sub-catchment

The Centennial Park South sub-catchment is predominantly urban and lies to the north of the racecourse. Piped flows from the sub-catchment discharge into Centennial Park at six outlets. The majority of overland flows from the catchment drain towards the southern end of Darley Road.

3.1.2. Centennial Park and Centennial Park East Sub-catchments

Centennial Park lies immediately to the north of Royal Randwick Racecourse and Alison Road. The Park contains large areas of man-made ponds that were developed over what were originally swamp areas. The Park is downstream of predominately urban areas. Due to its nature and size, the Centennial Park pond system has a significant impact on runoff response from the upper part of the catchment. This is particularly so in comparison with the more urbanised sub-catchments surrounding the racecourse site. The nature of the soils and interconnection with the underlying Botany Aquifer system produces a high infiltration rate and thus relatively low runoff from the Centennial Park pond system.

The Lower Kensington pond (at the downstream end of the Centennial Park ponds) discharges into a piped system under Alison Road and along Doncaster Avenue. Overflow from the pond traverses Alison Road, proceeds through the north-west corner of the racecourse site and continues along Doncaster Avenue.

3.1.3. Racecourse Sub-catchment

The racecourse receives direct runoff from the urban sub-catchment located to the east of the racecourse bounded by Frances Street to the north, Avoca Street to the east and Arthur Street to the south. This sub-catchment can be divided into two sections south and north of Alison Road. From the portion south of Alison Road both piped and overland flows discharge directly into the racecourse site. From the portion north of Alison Road, piped flows discharge directly into the racecourse site while the majority of overland flows travels west along Alison Road.

Piped flows from the racecourse sub-catchment discharge into the racecourse site from the southern section via a 900 mm diameter pipe and from the northern section via a 900 mm x 1200 mm box culvert from Wansey Road. These flows are combined via a 1200 mm pipe that discharges into a basin located near the 1400 m chute.

Flows from the 1400 m chute basin then discharge into another basin located between the 1400 m and 1200 m chutes via 900 mm and 450 mm diameter pipes. From the 1200 m chute basin, flows discharge via twin 225 mm diameter pipes to High Street. The inlet to these pipes is set approximately 2 to 3 m above the basin invert. Anecdotal evidence suggests that a significant amount of infiltration may occur before the water level in the basin reaches the piped outlet.

Overflows from the basin travel across the course proper and the internal track towards the inner and outer detention basins located at the southern end of the race track. Flows from these detention basins discharge via a 600 mm pipe to a pipe system downstream of the track and ultimately to Randwick City Council's drainage system near the corner of Doncaster Avenue/Anzac Parade and High Street.

3.1.4. Doncaster Sub-catchment

The majority of the racecourse lies within the Doncaster sub-catchment. Piped drainage from the racecourse site discharges into the Doncaster sub-catchment at three locations at Alison Road, Doncaster Avenue and High Street.

3.2. Hydrology

The response behaviour of the catchment is affected by a range of factors including (but not limited to):

- *High permeability of surface soils*. The eastern boundary of the catchment in the vicinity of Randwick CBD lies on a large aeolian sand dune. Aeolian sands are highly pervious and hence result in high infiltration rates in areas where they are exposed.
- *Centennial Park*. As noted previously, the park's pond system has a significant impact on the runoff response from the upper part of the catchment.
- The medium to high density urban development in areas external to the racecourse with few areas of open space. These developments are likely to have decreased

infiltration and thus may have increased the rate of runoff during a rainfall event.

- The underlying Botany Aquifer is a large sub-surface water body flowing to Botany Bay. The aquifer is connected to the surface water bodies in Centennial Park. The impact of the surface and groundwater interconnections is not addressed in this investigation.

3.3. Hydraulic Modelling

Detailed flood modelling has been undertaken to assess the flood behaviour in Alison Road and Doncaster Avenue in the vicinity of the racecourse site under existing and developed conditions.

Tasks undertaken as part of the flood modelling comprise of:

- The application of a range of inflow boundaries to the hydraulic model based on results from the SS – CP Flood Study;
- The development of a TUFLOW 2D hydraulic model over the racecourse site in its existing condition (April 2012) as well as prior to the initial construction works at the racecourse in 2008. This was undertaken to ensure that the cumulative effect of all works undertaken on the racecourse since 2008 are addressed as well as the incremental effect of construction of the hotel;
- Amendment of the TUFLOW 2D model to represent the developed conditions (i.e. construction of the hotel and associated works) in accordance with the drawings provided in Figure 3;
- The reviewing of flood model results for existing and developed conditions.

The TUFLOW 2D model consists of a 2 x 2 m 2D grid defining the ground elevations across the model extent. A digital elevation model (DEM) of the ground grid was defined based on aerial laser survey provided by Randwick City Council. The plan locations of buildings, walls, fences and other structures likely to obstruct flows were identified and their impacts on flow conveyance included in the DEM.

4. RESULTS

The impact map for the 100 year ARI design flood resulting from the proposed hotel and associated works compared to current conditions is shown in Figure 4. Flood impacts are calculated by subtracting base case results from the "proposed development" scenario and the difference is presented as an impact map. The only area exceeding the standard applied tolerance of 0.01 m is to the east of the proposed hotel. This impact is considered reasonable as it is contained within the lands of Royal Randwick Racecourse. Furthermore the water level increase there is attributable to the raising of the ground due to the proposed landscaping works and peak flood depths for the 100 year ARI event in fact reduce from approximately 0.77 m to 0.62 m. No impact is observed on existing buildings and the proposed hotel diverts waters away from the previously flooded grandstand onto the racetrack likely reducing risk to the public.

The 100 year ARI design flood levels (used for flood related development control purposes) at the proposed hotel site are shown in Figure 5. Contours at 0.1 m increments are superimposed onto the peak flood levels for clarity purpose.

Peak inundation depths for the 100 year ARI design flood are presented in Figure 6. As already mentioned the deep area east of the proposed hotel is in fact reduced due to the proposed filling of the depression there.

There are no significant changes to velocities or flows outside of Royal Randwick Racecourse.

5. CONCLUSIONS

An assessment of the potential impacts on flooding (levels, velocity and flows) from the construction of the proposed hotel within the grounds of Royal Randwick Racecourse has been undertaken by WMAwater. All other aspects relating to flooding and stormwater drainage have been addressed in separate studies.

WMAwater confirms that this report certifies that the proposed hotel works as described in Figure 3 of this report will have no significant impact (< 0.01m) in the 100 year Average Recurrence Interval (ARI) flood event on lands outside Royal Randwick Racecourse. As such the construction is in accordance with the principles of the NSW Floodplain Development Manual April 2005 and the Royal Randwick Racecourse DCP 2007.

Detailed flood modelling (using the TUFLOW model adopted for the Council funded flood study) has been undertaken to assess the flood behaviour in Alison Road and Doncaster Avenue in the vicinity of the racecourse site under existing (2013) and developed conditions.

In summary the change in floods levels (taken as greater than +/- 0.01m) are contained within the lands of Royal Randwick Racecourse. No impact is observed on existing buildings and the proposed hotel diverts waters away from the previously flooded grandstand onto the racetrack likely reducing risk to the public.

An additional comparison was made between the 100 year ARI design peak flood levels as a result of construction of the proposed hotel compared to the pre 2008 topography. Results show similar relative impacts to that indicated above indicating that the “cumulative effect” of works within Royal Randwick Racecourse does not increase flood levels above those previously adopted.

A dwarf wall joining the corner of the existing heritage gates to the bar area of the hotel is required in order to prevent any impact on the corner of Alyson Road and Darley Road. The level of the wall can be no less than 32.00 mAHD. No further mitigation measures are proposed and this report concludes that the works (with the inclusion of the dwarf wall) will not increase flood levels outside the grounds of Royal Randwick Racecourse to any significant extent (greater than 0.01m).

Figures

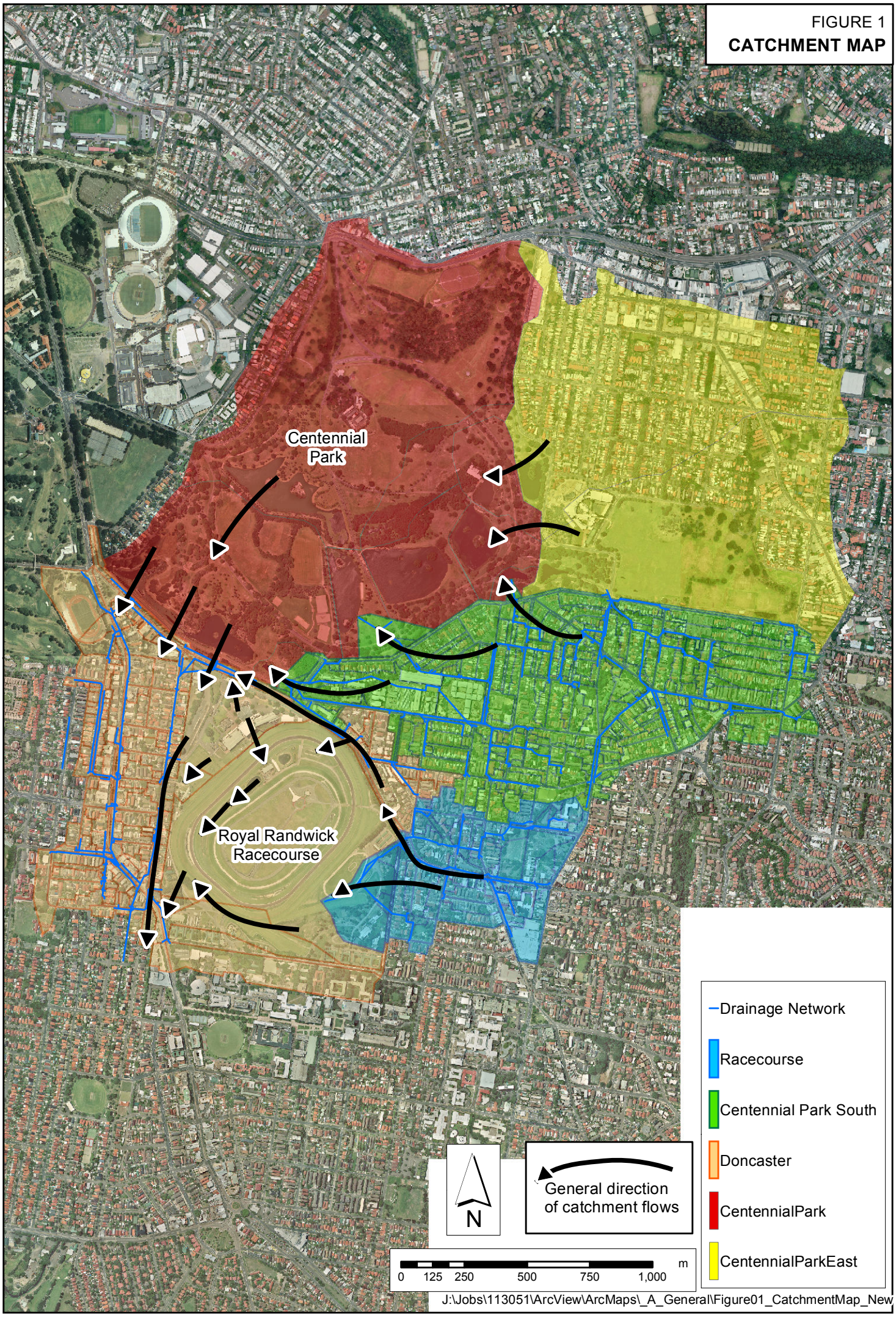


FIGURE 1
CATCHMENT MAP
Centennial Park
Royal Randwick Racecourse
N
General direction of catchment flows
0 125 250 500 750 1,000
m
Drainage Network
Racecourse
Centennial Park South
Doncaster
CentennialPark
CentennialParkEast
J:\Jobs\113051\ArcView\ArcMaps_A_General\Figure01_CatchmentMap_New

FIGURE 2
SITE LAYOUT

FIGURE 03

PROPOSED WORKS

DATE	REV	NOTES :
22.05.12	A	PLANNING APPLICATION ISSUE
19.11.12	B	PLANNING APPLICATION AMENDMENT
31.08.13	C	SUBMITTED WITH PREFERRED PROJECT REPORT

NOTES:
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DRAWING TITLE
GROUND LEVEL PLAN

DRAWN BY JB,RM
CHECKED TG
SCALES 1:200/A1 1:400/A3
DATE AUGUST 2013
PHASE PA
DRAWING NO A-1001
REVISION C

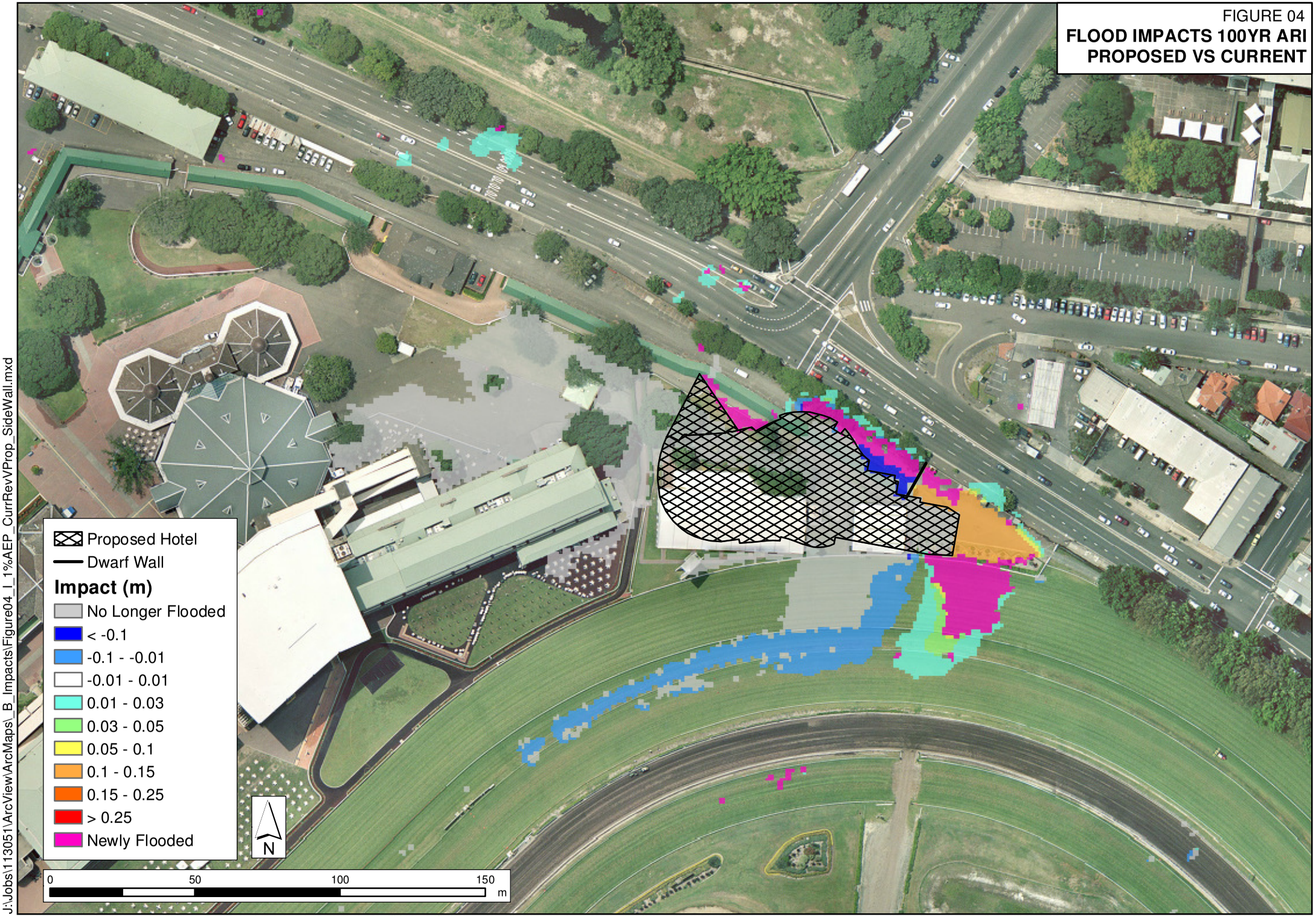
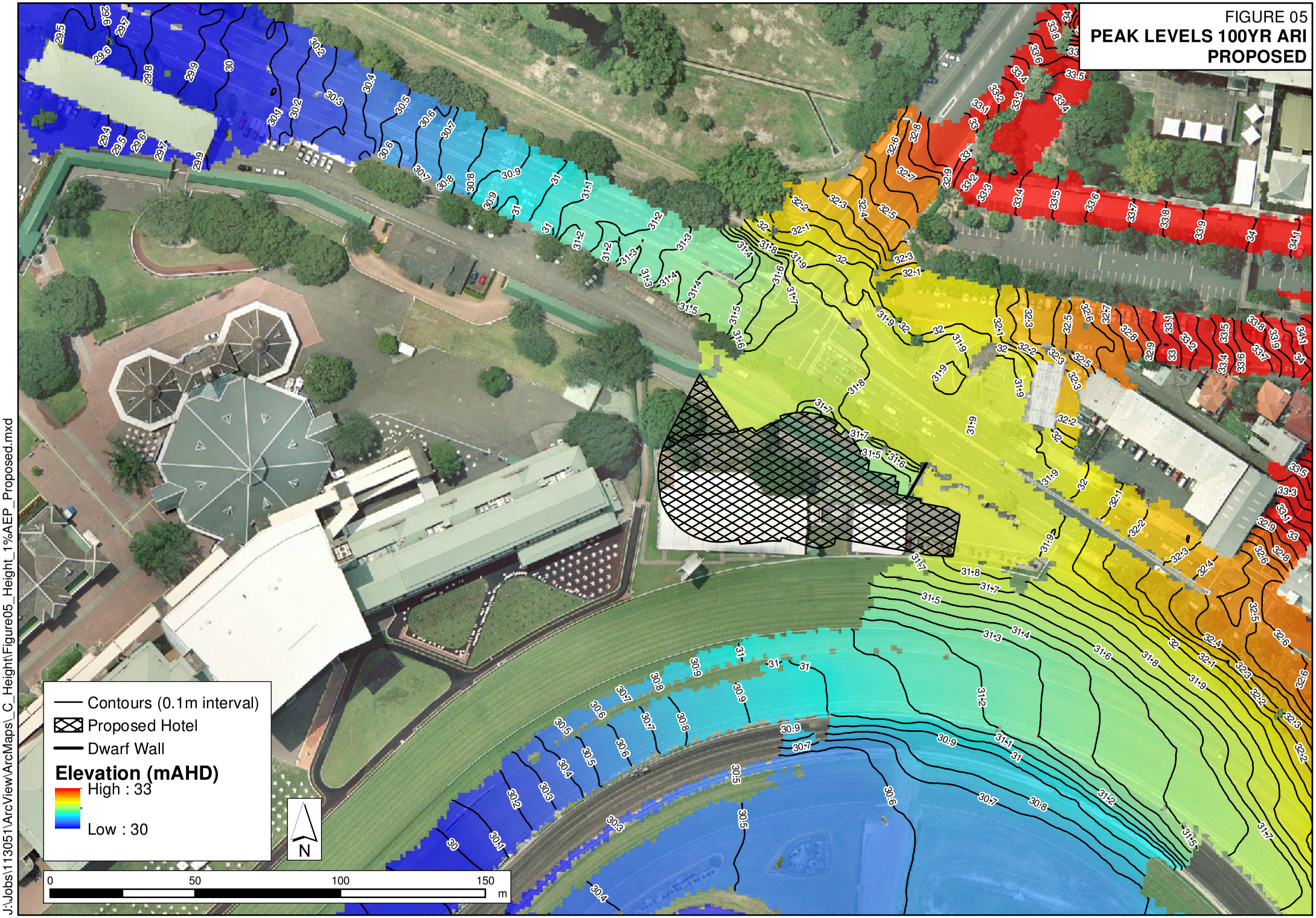


FIGURE 04
FLOOD IMPACTS 100YR ARI
PROPOSED VS CURRENT
Proposed Hotel
Dwarf Wall
Impact (m)
No Longer Flooded
< -0.1
-0.1 - -0.01
-0.01 - 0.01
0.01 - 0.03
0.03 - 0.05
0.05 - 0.1
0.1 - 0.15
0.15 - 0.25
> 0.25
Newly Flooded
N
0
50
100
150
m
J:\Jobs\113051\ArcView\ArcMaps_B_Impacts\Figure04_I_1%AEP_CurrRevVProp_SideWall.mxd

FIGURE 05
PEAK LEVELS 100YR ARI PROPOSED



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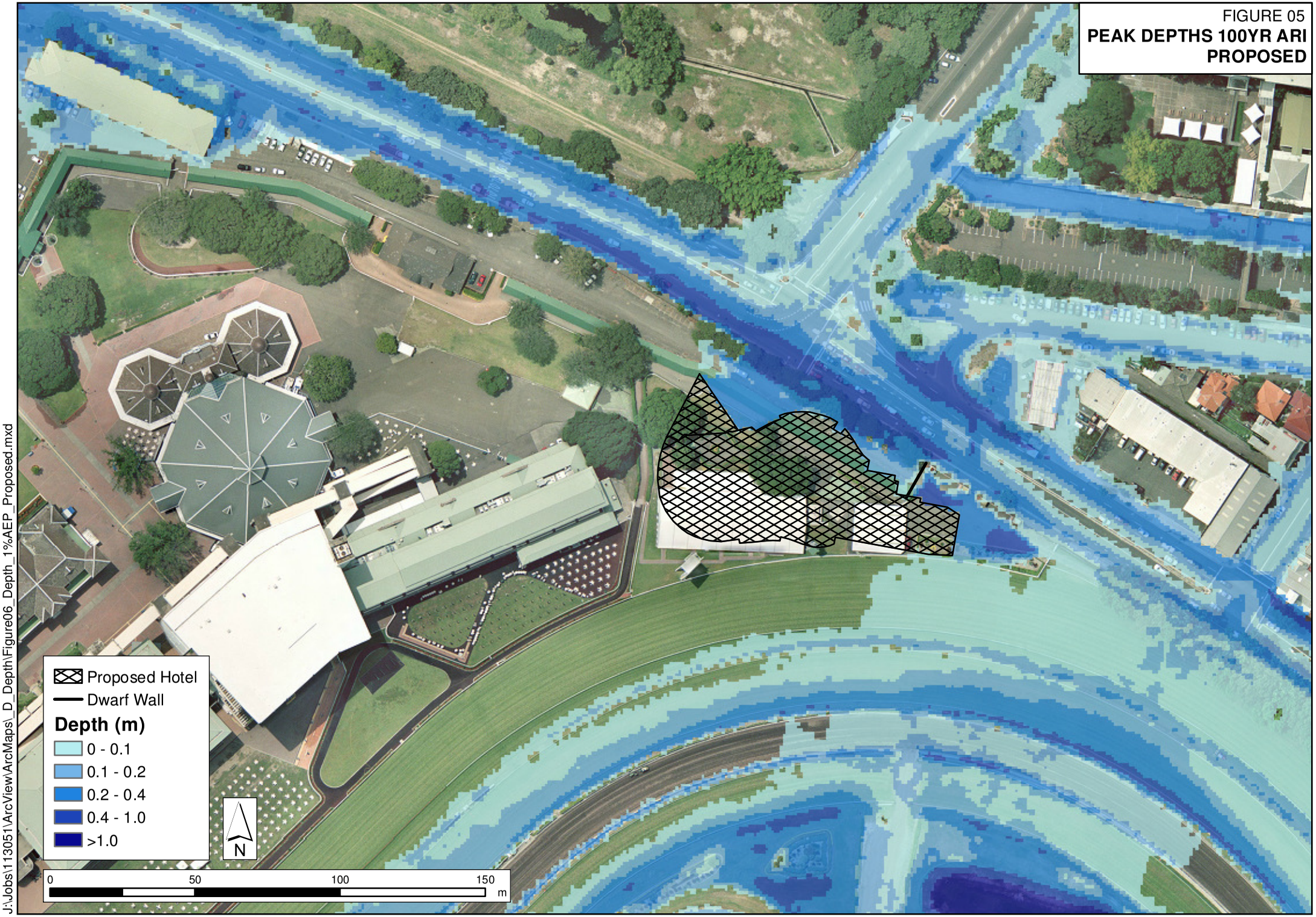
FIGURE 05
PEAK DEPTHS 100YR ARI
PROPOSED
Proposed Hotel
Dwarf Wall
Depth (m)
0 - 0.1
0.1 - 0.2
0.2 - 0.4
0.4 - 1.0
>1.0
N
0
50
100
150
m
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