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Coal & Allied

Addendum Report for Lower Hunter Land Project

Hydrology/Stormwater Management: Catherine Hill Bay further advice on WSUD, Water Quality and Climate Change

August 2008

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

Contents

Appendices

1. Background

The Coal & Allied Report for Lower Hunter Land Project - Phase 2, Hydrology/ Stormwater Management: Catherine Hill Bay was delivered in October 2007. This report was delivered to the Department of Planning in support of the Concept Plan application for the site and presented a Water Sensitive Urban Design (WSUD) strategy for the development at Catherine Hill Bay in response to a concept plan developed in Phase 1 of the investigations .The water sensitive urban design promoted opportunities for linking water infrastructure, landscape design and the urban built form to minimise the impacts of development upon the water cycle, water quality and achieve sustainable urban development.

In assessing the October 2007 report, a number of Agencies raised questions, requested further clarification and made recommendations to IHAP. This Addendum Report adds supporting information to the original report and provides further clarification where required.

2. Key changes to the Concept Plan

On the recommendations of IHAP, Coal and Allied have adopted the following key change to the Concept Plan as was originally submitted:

» The proposed development precincts C and D and the bypass road will be omitted from the development footprint.

3. Water Sensitive Urban Design (WSUD)

The principles of WSUD, as incorporated in the Lake Macquarie City Council Development Control Plan 1 (LMCC DCP 1). have been adopted for the management of stormwater and treatment of stormwater quality from this development. WSUD offers the best solutions for scrubbing pollutants and throttling runoff in an environmentally sympathetic way.. The intent of Council's requirements in this DCP in relation to stormwater management is to ensure systems are carefully planned, designed and located to prevent the disturbance, redirection, reshaping or modification of watercourses and associated vegetation and to protect the quality of receiving waters.

For the Catherine Hill Bay site the WSUD strategy included provision of on-lot systems to manage on-lot impervious area increases, with smaller precinct co-located bio-retention/ detention facilities to manage increased runoff due to primarily roads. This strategy includes:

» Onsite detention and bioretention system are proposed for individual lots. Approximately 4 % of the land is required for on-site detention facilities. The detention facilities would be combined with bioretention to provide the dual purpose of stormwater quantity and quality management;

» Precinct co-located bio-retention/ detention facilities are proposed at key locations. The required detention areas are estimated based on the contributing road sub catchments. In some locations these detention facilities would be combined with bioretention to provide the dual purpose of stormwater quantity and quality management;

» Opportunistic provision of swales and bio-retention swales adjacent to major roadways; and

» Rainwater tanks are recommended for each dwelling. The size of the tanks will be decided as part of the lot development process. Even though the purpose of rainwater tanks is for roof water harvesting and reuse, they also detain the stormwater flows to a certain extent. However this function was not included in assessing the required detention storage volume.

In all cases the intention is to provide these facilities within the development boundary and facilities would not be located in lands dedicated to others. The facilities would discharge to adjacent riparian or receiving environments, through outlets that would be designed to minimise the risk of erosion by providing rock or other environment sympathetic solutions. The WSUD strategy report submitted with the Concept Application presents RAFTS and MUSIC modelling results to show that Councils performance requirements in terms of stormwater quantity and quality management can be met.

In the case of Catherine Hill Bay, the development discharges would be routed to the basins. These would discharge to the conservation land via a number of outlets via existing overland flow paths. These overland flow paths may require erosion protection using rock and other environmentally acceptable strategies.

We believe that the WSUD strategy proposed would adequately protect the ecology of the receiving environment.

The location of precinct co-located bio-retention/ detention facilities is shown in Appendix A.

4. Flood Modelling

Preliminary flood modelling supports the Concept Application Report. To answer IHAP and Agencies queries regarding this flood modelling, we offer the following additional

information regarding the methodology used to derive flood information. We believe the information provided suffices for the planning stage of the project, and would agree that a more detailed Floodplain Risk Management Study should be undertaken in the sub-division design stages. More detailed flood modelling and flood mapping would support this work.

The hydrology for Middle Camp Gully was developed using the RAFTS simulation software. The development of this hydrological model included:

» Sub-catchment delineation;

» Intensity-Duration-Frequency data for generating storm rainfall events according to the Australian Rainfall and Runoff; and

» Estimates of lag, catchment roughness and infiltration.

The model was simulated for the 1% AEP flood events and the PMF for the existing climate and for climate change conditions. The results were exported to the TUFLOW hydraulic model.

Flood levels, velocities, flood extents and flood hazard where determined with the 2 dimensional TUFLOW hydraulic model. TUFLOW is a hydraulic model for simulating depth-averaged, two and one-dimensional free surface flows. Data is input through the use of text files for controlling simulations and simulation parameters. MapInfo files are used to represent spatially distributed data such as topography, hydraulic structures and boundary conditions.

The TUFLOW model compilation was undertaken as follows:

» The available 2 m contour data for the site was imported into the digital terrain model program 12D. The Middle Camp Gully area was extracted and triangulated into a Digital Terrain Model (DTM) to represent the ground surface;

» A TUFLOW grid was generated with a cell size of 2 m. Each point in the grid was given an elevation based on its location in the 12D DTM. The grid size was chosen because this is a compromise between the accuracy of the DTM data, simulation run time, model stability, and the accuracy of the results;

» No road crossings were simulated at this early planning stage, and thus the modelling represents conservative scenario (worst case) of blocked culverts;

» Supplied cadastral information was imported into GIS program and the aerial photography geo-referenced;

» The sub-catchments used in the Rafts hydrologic modelling were applied as inflows over the 2-D model, with inflows distributed and divided over the model grid points;

» Based on aerial photography and site inspections, hydraulic roughness coefficients for the floodplain were recorded for the model. These coefficients were digitised into MapInfo as polygons to represent the various surfaces.; and

Downstream control was estimated as 2.5 m AHD, allowing for mean high water (approximately 1 m AHD) plus 1 m wave run up plus 0.5 m for combined wind and barometric set-up.

In the absence of corresponding rainfall (hyetograph) and runoff data, calibration of the TUFLOW model was not possible. Furthermore no historic flood markers were available for calibrating of overland flood depths. Calibration of the model was thus limited to checking the "reasonableness" of the overland flow routes and depths, and qualitatively comparing the findings to known flooding occurrences.

The extent of inundation and flood hazard are shown in Appendix B. Referring to:

» From Figure B.1: The lots are unaffected by the 100-year ARI flood event, although some of the roads in Precinct B would be flood affected. Not withstanding this, floor levels of dwellings would need to be located a freeboard of 0.5m above the 100-year ARI flood level;

» From Figure B.1: In the context of the NSW Floodplain Development Manual, a total of 5 lots would be affected by the PMF and would therefore be designated as flood prone, in addition some of the roads would be further affected by flooding;

» From Figure B.2: With exception to the eastern edge of Precinct B all high hazard flooding in a 100-year ARI is restricted to the vicinity of the creek lines; and

» From Figure B.2: It is noticeable, that the access road to Precinct B crosses an intermediate hazard zone and this road crossing would require careful design to provide adequate evacuation.

5. Climate Change and Flooding

The Lake Macquarie City Council report Planning Levels and Other Adaptation Reponses to Sea Level Rise and Climate Change, accepted:

" that sea level rise is a well-documented phenomenon over the last fifty years. The best available scientific evidence at hand suggests an increase in sea levels over the current century. Council is aware of the growing risk from sea level rise and climate change.

Accepting a sea level rise prediction of 0.91m for the period up to 2100 will address Council's immediate 'duty of care' responsibilities. After consultation, and using the resulting figure as a basis, development of future adaptation and planning initiatives will allow Council to act on the side of reasonable caution in addressing climate change related impacts.

Increased ocean levels and increased frequency and severity of flood-producing rain events require an urgent response, with a recommended immediate increase in the habitable floor heights in areas predicted to be affected by sea level rise. However, flood behaviour is site specific and future flood studies and floodplain risk management studies will consider the implications of climate change as part of strategic

management of flood risk, as required by the NSW Floodplain Development Manual 2005."

"The best available advice from the Department of Environment and Climate Change (DECC Practical Consideration of Climate Change, October 2007) indicates that sea level rise on the NSW coast is expected to be in the range of 0.18 to 0.91m by between the years 2090 and 2100.

It is proposed that Council adopt a provisional sea level rise figure for the year 2100 of 0.91m in order to err on the side of reasonable caution and provide an approach based on the precautionary principle. The adoption of this figure equates to 10 mm per year rise up to the year 2100."

"The effect of adopting the above figure is that development consents this year for buildings potentially affected by sea level rise will require 10 mm to be added to the required floor height for each year of the buildings' designated economic life.

The DECC Practical Consideration of Climate Change, October 2007 guidelines recommend that the following sensitivity analyses be undertaken for sea level where relevant to the study area:

» 0.18m (Low Level Ocean Impacts)

» 0.55m (Mid Range Ocean Impacts

» 0.91m (High Level Ocean Impacts)

In addition until more work is completed in relation to the climate change impacts on rainfall intensities the following sensitivity analyses are recommended:

Rainfall Intensities. Increases of:

» 10% in peak rainfall and storm volume

» 20% in peak rainfall and storm volume

» 30% in peak rainfall and storm volume

For the Catherine Hill Bay site the high level ocean impact scenario was adopted, together with the 30% increase in storm rainfall intensity and storm volume. This was considered an upper envelope of climate change for a 2100 planning horizon. On this basis, the RAFTS and TUFLOW models were resimulated.

As a downstream boundary a level of 4.0m AHD was adopted. This included 1.5 m for wave run up, 0.4 m for barometric setup and 0.2m for wind setup on top of the ocean level rise of 0.91 m applied to the above existing climate mean high water level of 1.0 m AHD.

The impacts of the above climate change scenarios are shown in Appendix B. Referring to:

» Figure B.3: The flood extents in the 100-year ARI climate change scenario increase by a small amount adjacent to the precincts. Downstream of the precinct the effect is more dramatic, where backwater effects from elevated ocean levels dominate. In this climate change event, still no lots are inundated and;

» Figure B.4: In a 100-year ARI event, flood levels adjacent to the site are expected to increase no more than 0.3 m. While this does not cause a significant increase in flood extent, dwelling floor levels would need to consider these impacts.

6. Conclusion

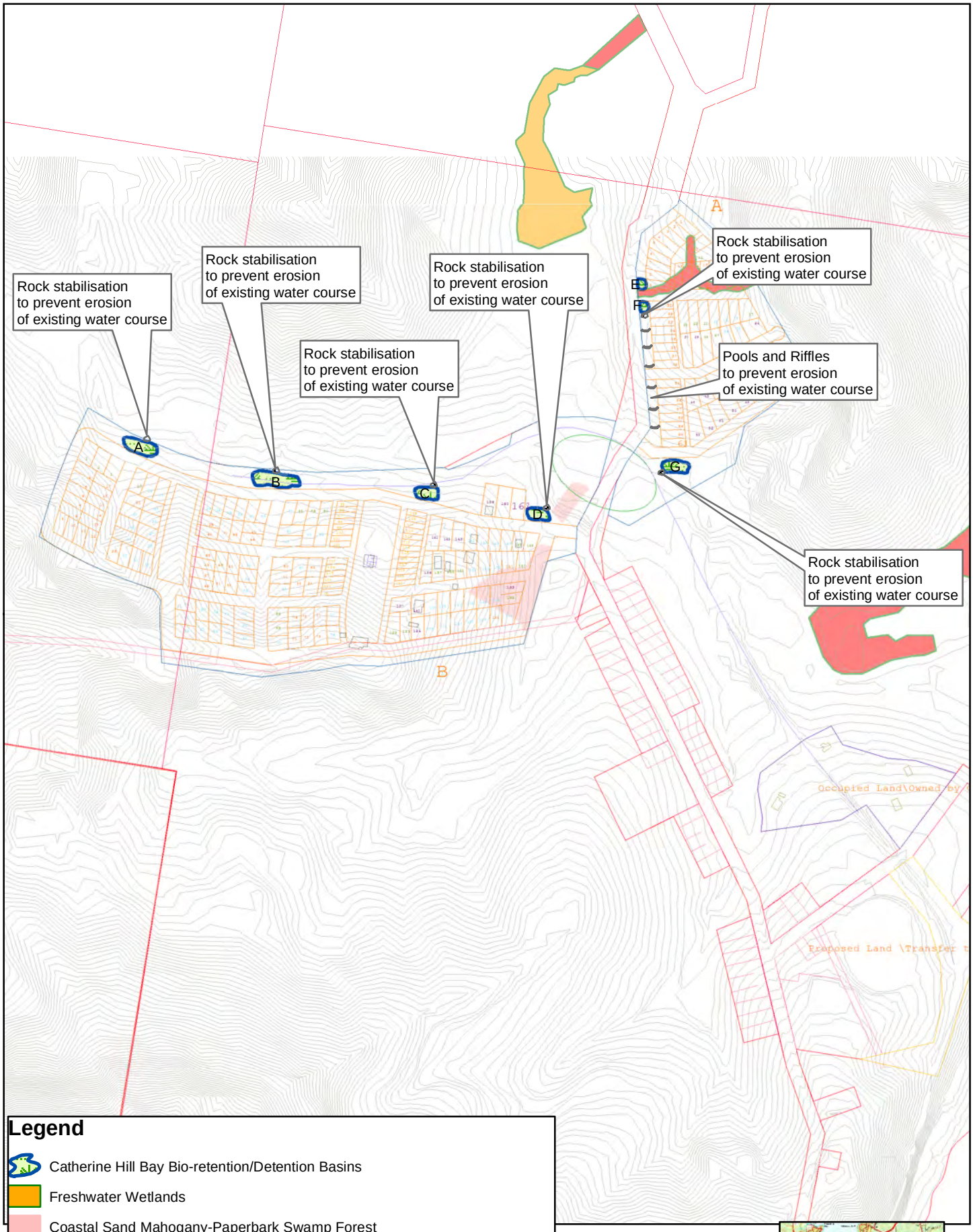
This addendum provides additional information addressing the issues raised by IHAP and the Agencies. Our conclusions are that:

» The WSUD measures proposed will provide the best outcome for treatment of stormwater and protection of the water quality in the receiving environment. Treated site discharges would be routed to the conservation land via a number of basins. From here the discharge would drain to the Middle Camp Gully via existing overland routes; and

» At the site all lots are located above the 100-year existing climate and 2100 climate change with freeboard flood levels. Minor affectation of internal roads and the access road to Precinct B road is expected. For the PMF scenario, 5 lots would experience a minor flood impact. In a 100-year ARI event, flood levels adjacent to the site are expected to increase no more than 0.3 m. While this does not cause a significant increase in flood extent, dwelling floor levels would need to consider these impacts. A more detailed Floodplain Risk Management Study would be undertaken in future sub-division design stages of the project, supported by more detailed flood modelling and flood mapping.

Appendix A

Location of WSUD Precinct Facilities



Legend

- Catherine Hill Bay Bio-retention/Detention Basins
- Freshwater Wetlands
- Coastal Sand Mahogany-Paperbark Swamp Forest
- Narrabeen Foreshore Redgum-Ironbark Forest (Redgum rough barked variant)
- Narrabeen Alluvial Drainage Line Complex (Shallow drainage variant) [26b]
- Estuarine Swamp Oak Forest

1:7,500
0 0.015 0.03 0.06 0.09 0.12
Kilometres (at A4)
Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

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Catherine Hill Bay Bioretention/Detention Basin Locations

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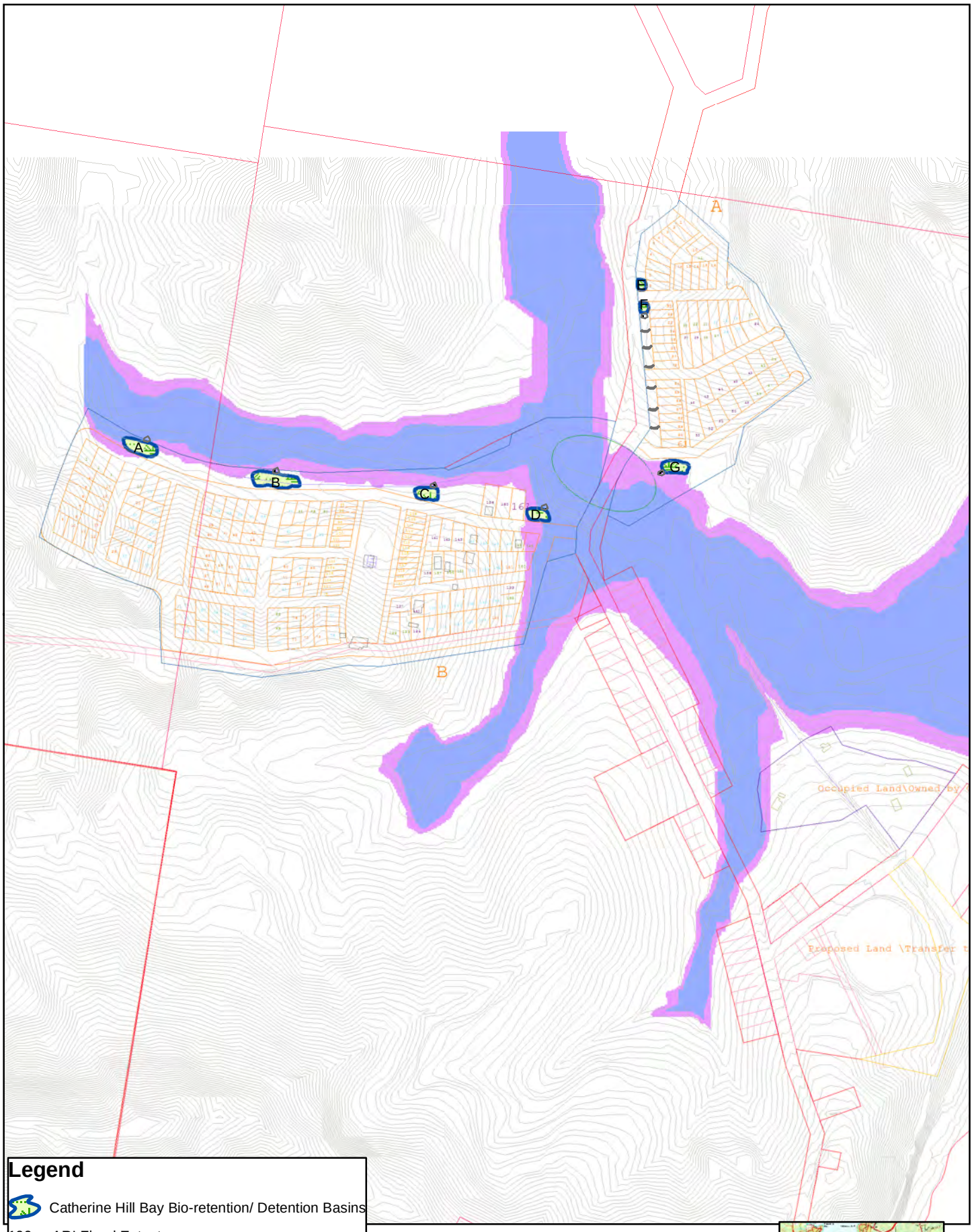
Data source: Data Custodian, Data Set Name/Title, Version/Date. Created by: C Pappin

10 Bond Street Sydney NSW 2000 Australia T 61 2 9239 7000 F 61 2 9239 7199 E sydmail@ghd.com.au W www.ghd.com.au

Appendix B

Flood Maps



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Catherine Hill Bay Bio-retention/ Detention Basins

100-yr ARI Flood Extents

PMF Flood Extents

1:7,500

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Kilometres (at A4)

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

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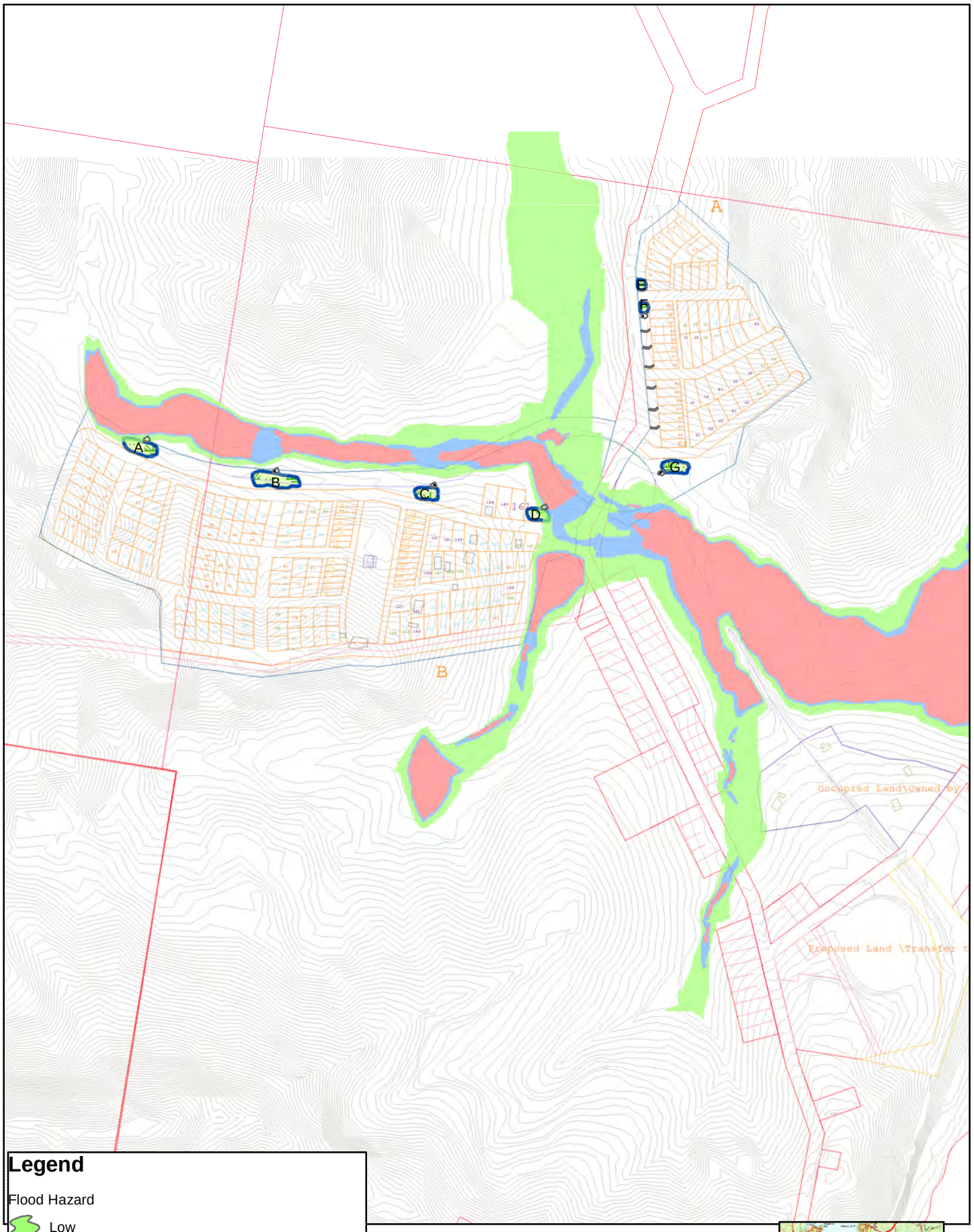

Legend

Flood Hazard

- Low
- Intermediate
- High
- Catherine Hill Bay Bio-retention/ Detention Basins

1:7,500

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Kilometres (at A4)

Map Projection: Transverse Mercator
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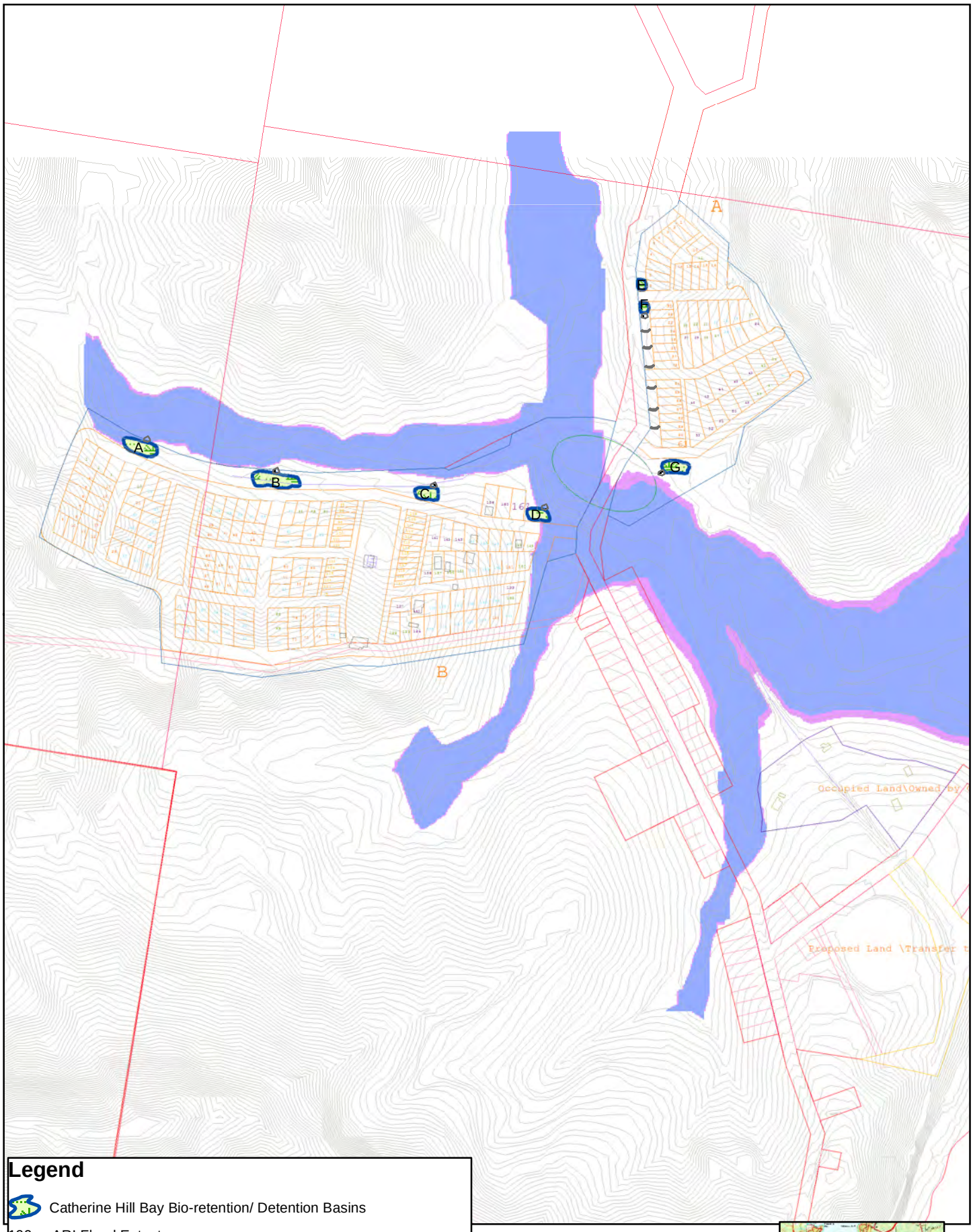

Legend

Catherine Hill Bay Bio-retention/ Detention Basins

100-yr ARI Flood Extents

100-yr ARI Flood Extents 2100 climate (30% increase in rainfall intensity)

1:7,500

0 0.015 0.03 0.06 0.09 0.12

Kilometres (at A4)

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

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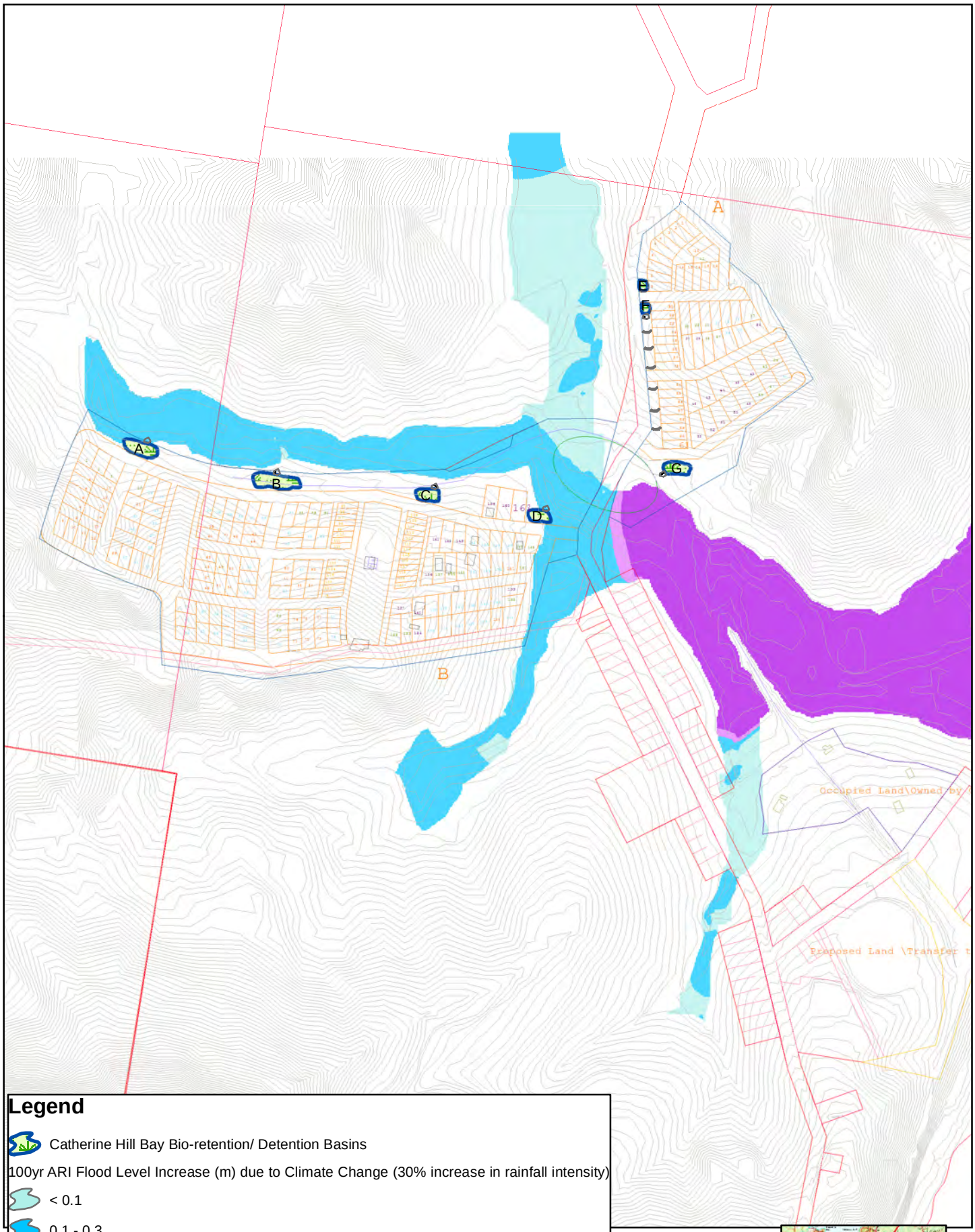

Legend

Catherine Hill Bay Bio-retention/ Detention Basins

100yr ARI Flood Level Increase (m) due to Climate Change (30% increase in rainfall intensity)

- < 0.1
- 0.1 - 0.3
- 0.3 - 0.5
- 0.5 - 1
- > 1.0

1:7,500

0 0.015 0.03 0.06 0.09 0.12

Kilometres (at A4)

Map Projection: Transverse Mercator
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