REPORT

Leamac Property Group &
Coronation Property Co. Pty Ltd

Moore Point Precinct

Flood Impact Assessment

April 2020

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1. EXECUTIVE SUMMARY

This Flood Impact Assessment Report has been prepared by J. Wyndham Prince on behalf of Leamac Property Group & Coronation Property Co. Pty Ltd to understand the impact of the development in relation to a Planning Proposal at Moore Point, Liverpool (the site).

The site is located east of Liverpool CBD on the opposite side of the Georges River and north of Newbridge Road. It provides a site area of 38.5 hectares (approx.) and is currently developed with industrial uses. It's important to note that there is nothing contained within this report to preclude rezoning of the site to it intended land uses.

The site is situated within Liverpool Collaboration Area's Georges River North precinct and is subject to the priorities and actions of the Liverpool Place Strategy (Strategy), which was released by the Greater Sydney Commission (GSC) in December 2018. The Strategy states that by 2036 Liverpool will be a rejuvenated river city, offering diverse and growing residential and employment opportunities. Major health, education and retail precincts, and a mixture of open spaces and parklands alongside the Georges River, will create a rich mix of jobs and workplaces, public spaces, shops and entertainment.

Under the Strategy the site is identified as 'mixed use', which comprises: 'a mixture of commercial, retail, residential and community uses that provide sustainable employment, that is complementary to, and not in competition with, the commercial core'.

The 2019 Annual report summary for Liverpool Collaboration Area highlighted key steps commenced and completed to address the imperatives acknowledged in the Strategy to accelerate the delivery of the Collaboration Area. These included:

- Engagement with TfNSW to prepare the Liverpool Place-based Integrated Transport Strategy and accelerated investment; and
- Flood studies and floodplain risk management plan completed by Liverpool City Council.

The land uses reflected in the Strategy are reinforced in Liverpool City Council's Local Strategic Planning Statement (LSPS), which identifies the site for investigation as residential/mixed use to support the CBD and Innovation Precinct in tandem with linking open space and green corridors.

The LSPS provides the following short to medium term action (12-24 months) specific to the Georges River North precinct:

> *Action 11.2 – Investigate amendments to LEP to rezone River precinct north of Newbridge Road (Moore Point) as a mixed-use zone to support the Liverpool CBD and Innovation Precinct, with an extensive open space system and cross-river linkages (short to medium term)*

The Planning Proposal involves the creation of a mixed use precinct, providing new homes, jobs and open space adjoining the Georges River and connecting to Liverpool CBD.

Key features of the proposal include:

- Adaptive re-use of existing heritage item;
- Foreshore embellishments and new open spaces;
- Educational and cultural facilities
- Connections to Liverpool CBD and Train Station; and
- Transport, intersection and collector road improvements

The Planning Proposal aligns with the priorities of Government and the implementation phase of the Place Strategy by facilitating the transformation of the Collaboration Area with new jobs, infrastructure, green spaces and housing. The Planning Proposal responds to The Pulse of Greater Sydney's performance indicators, which sit under the following key themes:

Infrastructure and Collaboration

The Planning Proposal will facilitate additional jobs, education and housing in close proximity to Liverpool CBD and Train Station. The proposal will support additional medium and long-term housing supply in Liverpool CBD through diverse and new housing products. The proposal supports the continual expansion and growth of Liverpool Innovation precinct and nearby health infrastructure, with potential to provide complementary uses near Liverpool Hospital and educational and cultural facilities on the site.

Productivity

The Planning Proposal supports the growth of the thirty-minute city, ensuring Liverpool emerges as a premier CBD in the Western City. The proposal provides capacity for new transport infrastructure on the site, road and intersection upgrades and locating density near major transport infrastructure (Liverpool Train Station and Badgery's Creek Aerotropolis). The proposal encourages additional business activity and investment in Liverpool by providing new commercial uses that will complement Liverpool CBD.

Liveability

The Planning Proposal significantly improves upon the existing use of the site by creating walkable places for people to live work and play. This includes foreshore embellishments to the Georges River, improved connections across the Georges River and adaptative re-use of existing heritage items. These measures will contribute to Sydney's Green Grid, improve access to services in Liverpool CBD and establish a community that celebrates identity and place.

Sustainability

The Planning Proposal addresses the urban heat island effect by significantly increasing the quantum of green space on the site for active and passive recreational use. The proposal will provide new parks and green connections to surrounding open spaces including Haigh Park, which will contribute to the urban tree canopy of the area.

Overall, the Planning Proposal represents a clear and consistent strategic line of site with the priorities of government. It meets the performance indicators, priorities and objectives expressed in the District Plan, Place Strategy, LSPS and The Pulse of Greater Sydney.

Nothing contained in the body of this report/assessment would preclude the Planning Proposal from rezoning and gazettal for residential/mixed use purposes.

Over recent years a total of nine (9) flood studies have been completed which all ascertain that the precinct can be made suitable for development with minor adjustment through controlled cut and fill that have no adverse impacts of the surrounding flood regime. All NSW and Federal Floodplain guidelines have been adhered to the preparation of this study. All future studies can be completed at Development Consent stage with controls implemented through the consent conditions to reflect any outcomes required.

The conclusion of this assessment are categorised into appropriate Flood management and consider water quantity management.

Flood Management

As part of these investigations, the current floodplain storage during the 1% AEP event has considered the proposed development landform and regional floodplain reclamation strategy. The proposed implementation of the two (2) flood storages and on the banks of the George River adjacent to the western motorway will result in an increase in the available floodplain storage by 31,980 m^3. Notwithstanding, the detailed flood assessment completed for the strategy has demonstrated that, with the Moore Point Precinct, peak flood levels in surrounding properties and within the Georges River will not increase as compared to 'existing' conditions in the catchment in the 1% AEP events. Importantly, provision of the proposed flood levee to the south of Newbridge Road will also reduce the extent of flooding within the Moorebank area, which is therefore considered to be an improvement upon current "existing" conditions.

Water Quantity Management

Peak flow results determined as part of the hydrologic modelling demonstrate that the precinct provides only 0.1% increase on the total peak flow in the Georges River and therefore, any changes to the characteristics of the precinct as a result of the Moore Point Precinct will unlikely impact the flow regime of the Georges River. Thus, the provision of onsite detention is not considered necessary for the Moore Point Precinct. Further assessments will be undertaken to confirm that detention is not required as part of the future development application process.

2. THE EXISTING ENVIRONMENT

2.1. Overview

The site is located east of Liverpool CBD on the opposite side of the Georges River and north of Newbridge Road. It provides a site area of 38.5 hectares (approx.) and is currently developed with industrial uses.

The site is situated within Liverpool Collaboration Area's Georges River North precinct and is subject to the priorities and actions of the Liverpool Place Strategy (Strategy), which was released by the Greater Sydney Commission (GSC) in December 2018. The site location is shown in **Plate 2-1**.

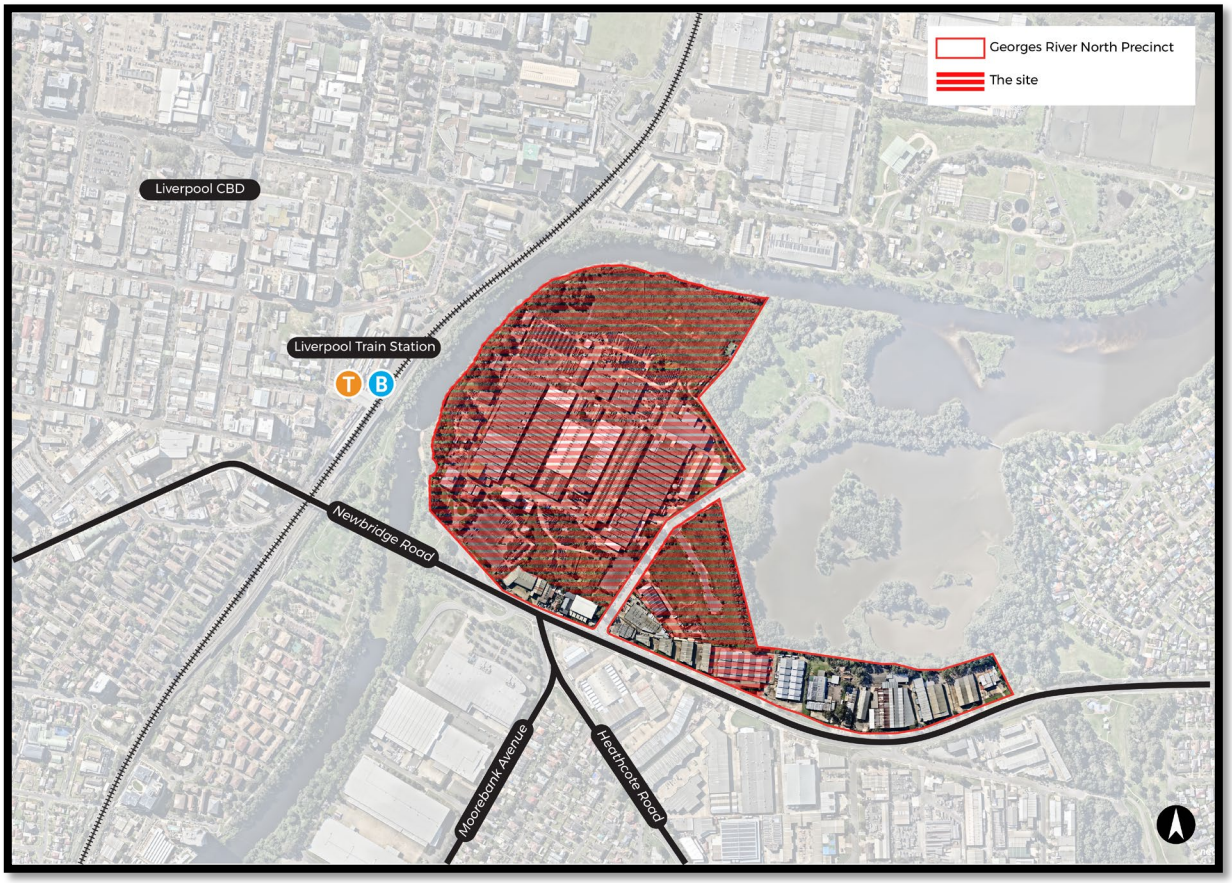

Plate 2-1 – Precinct Locality Map

The precinct is currently zoned as IN2 – Light Industrial and is primarily used for industrial/commercial purposes, with open space located throughout the precinct. The current industrial land use results in an overall percentage imperviousness of approximately 90%. The precinct is relatively flat, with grading towards Georges River and Lake Moore at approximately 0.7%.

Key precinct constraints have been identified, including the following:

- Existing Endangered Ecological Communities were recorded along riparian zones within the study area;
- An existing building within the precinct, which is currently being used as part of a cable manufacturing facility, is proposed to be retained to increase the historical and cultural offerings;

During the 1% AEP event, the precinct is partially inundated by mainstream flooding, which breach the banks of the Georges River. Current flood modelling for the area has determined that during the 1% AEP event the depth of small ponding occurs within the precinct with pockets of depth up to 2 m. For details of the existing flood constraints on the precinct, refer to **Section 6**.

2.2. Heritage items

Eco Logical Australia (ELA) have undertaken an Aboriginal Heritage and Historical Heritage Assessment for the Moore Point precinct in 2016 for LAC JV Pty Ltd. The assessment concluded that a portion of the precinct at 1 Bridges Road is identified as a heritage item under Schedule 5 of the Liverpool LEP 2008 and is known as the former Pirelli Power Cables and Systems Building, now known as Liverpool Waterfront Cables and Systems (item no. 76).

The Moore Point precinct site has the potential to impact on the Pirelli Power Cable and Systems Buildings. The study concluded that the current listing of the Pirelli site is vague in that it applies to the entire site, as shown in **Plate 2-2**, whilst the information on the State Heritage Inventory mainly describes the two-story brick administration building. The study has recommended undertaking a further assessment of the heritage values of the site so that the listing on the LEP Heritage Schedule be clarified as significant parts of the site have very little to no heritage value.

Plate 2-2 – Heritage Item and conservation area in or in the vicinity of the study area
(Source: Historical Heritage Assessment, ELA 2016)

It is noted that the early cable factory as seen in aerial 1943 is retained in its natural state in the Moore Point precinct development. The **Plate 2-3** shows majority of the precinct under cultivation and cable factory adjacent to the Georges River.

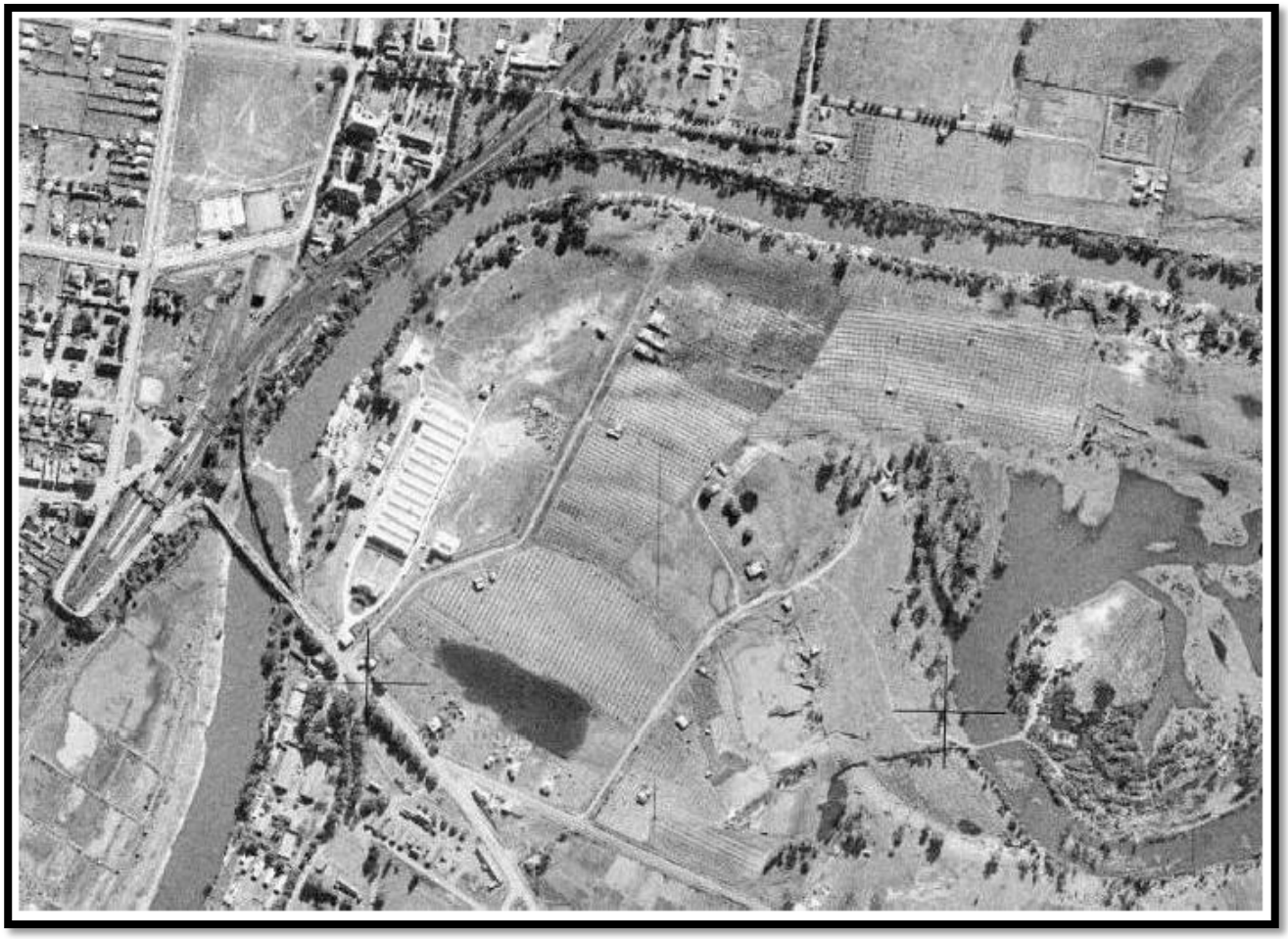

Plate 2-3 – 1943 Aerial Image of the Liverpool Waterfront Precinct
(Source: Historical Heritage Assessment, ELA 2016)

3. THE PROPOSED DEVELOPMENT

3.1. The site

A planning proposal is to be submitted to Council in support of an amendment to the Liverpool Local Environmental Plan (LEP) 2008. The proposal is to rezone approximately 38.5 ha parcel of land to accommodate a new integrated mixed-use development. The precinct master plan is shown in **Plate 3-1**.

The Planning Proposal involves the creation of a mixed use precinct, providing new homes, jobs and open space adjoining the Georges River and connecting to Liverpool CBD. Key features of the proposal include:

- Adaptive re-use of existing heritage;
- Foreshore embellishments and new open spaces;
- Educational and cultural facilities;
- Connections to Liverpool CBD and Train Station; and
- Transport, intersection and collector road improvements.

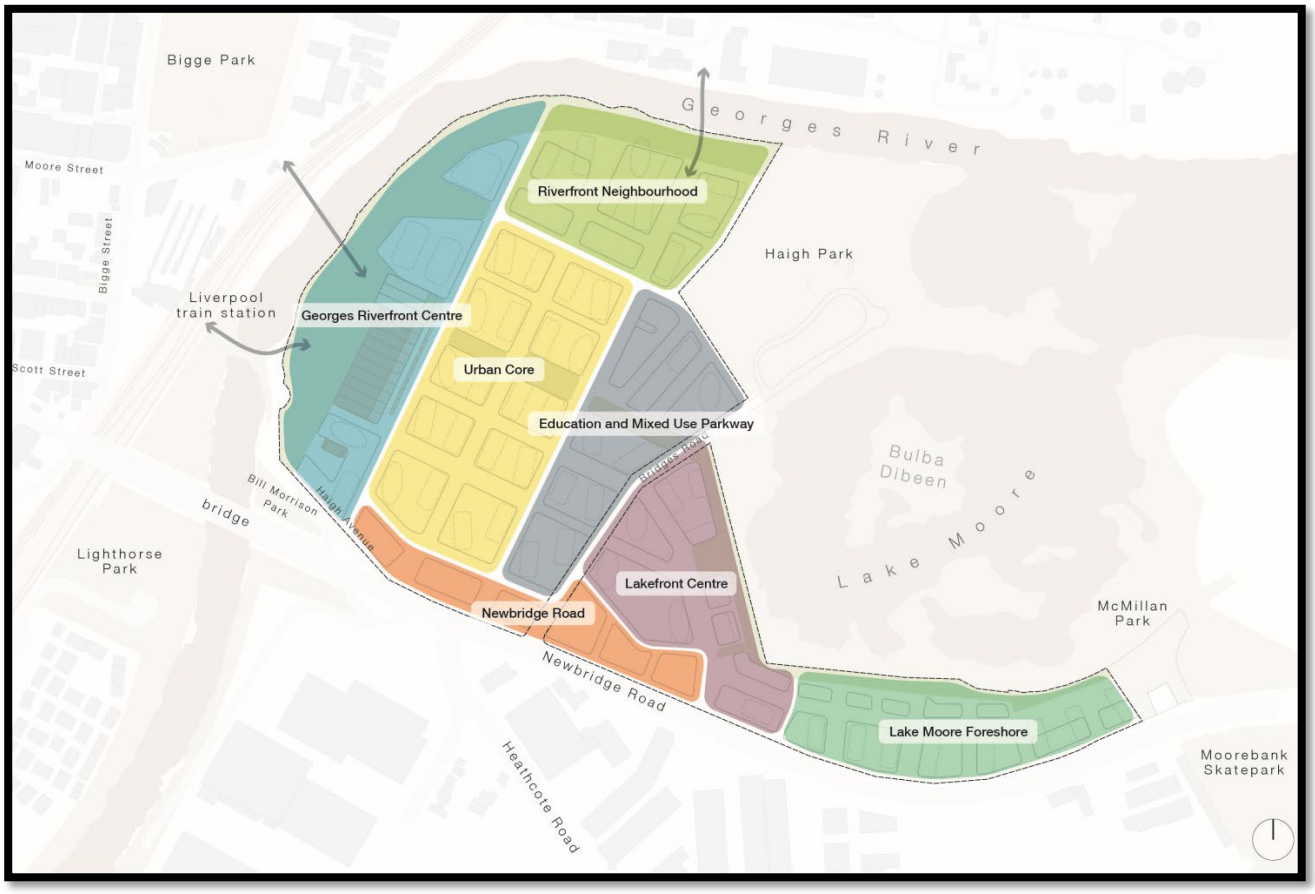

Plate 3-1 –Precinct masterplan

3.2. Regional context

The Liverpool Collaboration Area considers multiple stakeholders and is organised by the Greater Sydney Commission. The purpose of this area is to solve the complex urban issues that are anticipated with the future growth of the Liverpool LGA in order to achieve better outcomes for the area. The area is shown below on **Plate 3-2**.

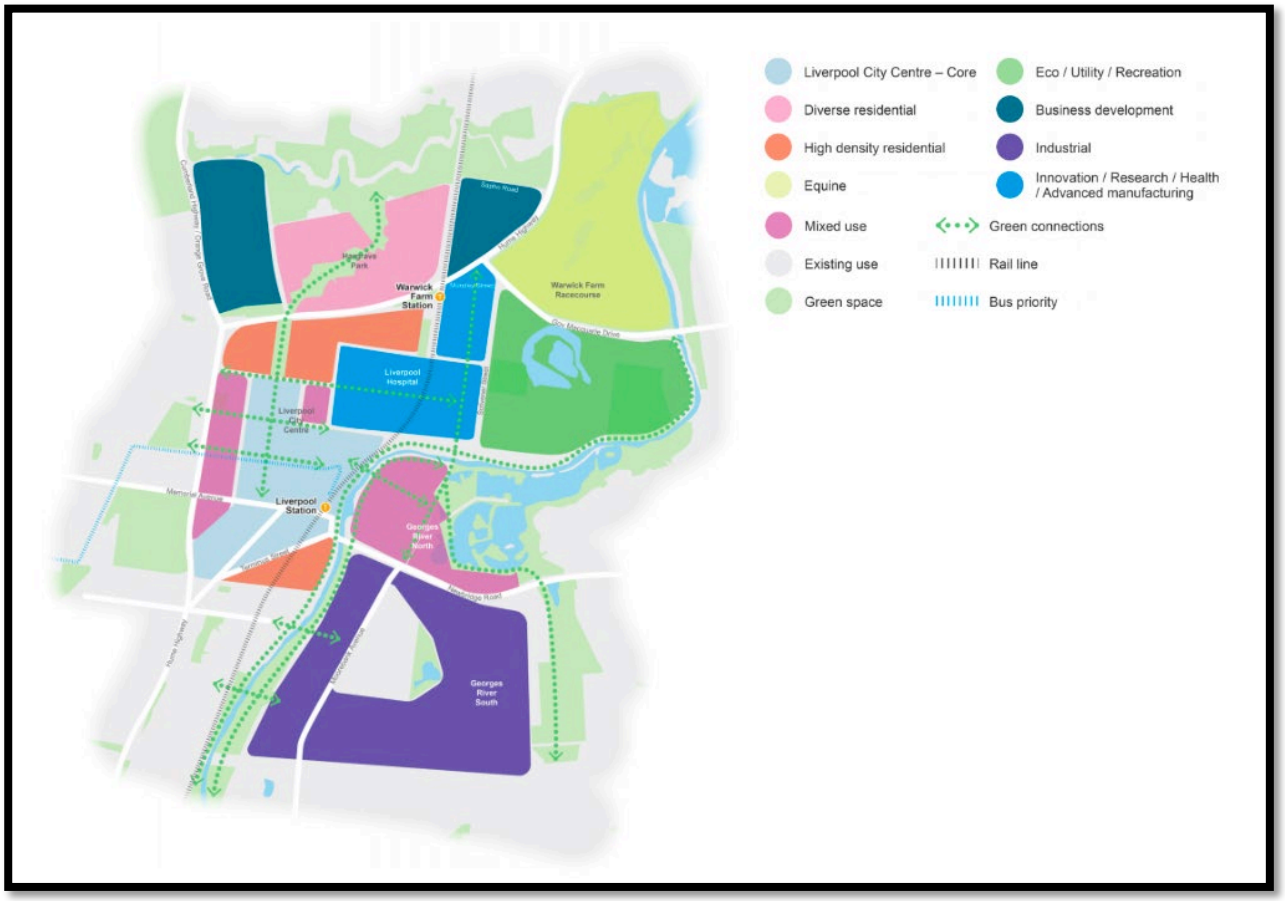

Plate 3-2 – A Place Strategy for Liverpool (Source: Liverpool Collaboration Area Place Strategy 2018)

The Liverpool Place Strategy identifies 10 key priorities for the Liverpool Collaboration Area to address the issues of connectivity, liveability, productivity, sustainability and governance. Priority eight (8) is to "*Develop a network of high-quality open space linked by the Greater Sydney Green Grid and invest in improvements to the Georges River and its foreshores*".

As part of addressing the sustainability priorities and actions, the report highlights that future development close to the Georges River must address flooding challenges. Action item 24 is to *"Prepare a floodplain constraints categorisation study (led by Council) and a flood evacuation study (led by State Emergency Service)*". Currently, Council is undertaking the flood constraint study and the State Emergency Service will be undertaking the flood evacuation study in the near future. An important consideration for the redevelopment of the Moore Point precinct will be to consider the following regional constraints:

- Localised flood impact; and
- Precinct flood evacuation strategy.

4. DEVELOPMENT CONTROLS AND PREVIOUS STUDIES

The following guidelines were considered in developing the Flood Management Strategy for the Moore Point precinct.

4.1. Liverpool City Council (LCC) Development Control Plan (2008)

The Liverpool Development Control Plan (LCC, 2008) identifies the following objectives for consideration with regard to Water Cycle Management, development near a watercourse and flood risk:

4.1.1 Water cycle management

- To ensure that development does not adversely impact on flow patterns from that of an undeveloped natural catchment;
- Prevent bed and bank erosion and instability of waterways; and
- Provide sufficient environmental flows to support aquatic environments and ecological processes.

4.1.2 Development near a watercourse

- To protect, restore and maintain ecological processes, natural systems and biodiversity in wetlands and waterfront areas;
- To maintain watercourse bed and bank stability;
- To minimise sedimentation and pollution of watercourses and wetlands;
- Ensure conservation and long-term maintenance of existing native vegetation in waterfront areas;
- To maintain lateral connectivity between waterways and riparian vegetation; and
- To protect the visual amenity of the water and land interface.

4.1.3 Flooding risk

- To minimise the potential impact of development and other activity upon the aesthetic, recreational and ecological value of the waterway corridors;
- To ensure essential services and land uses are planned in recognition of all potential floods;
- To reduce the risk to human life and damage to property caused by flooding through controlling development on land affected by potential floods;
- To ensure that the economic and social costs which may arise from damage to property due to flooding is minimised and is not greater than that which can be reasonably managed by the property owner and general community;
- To limit developments with high sensitivity to flood risk (e.g. critical public utilities) to land with minimal risk from flooding;
- To prevent intensification of inappropriate use of land within high flood risk areas or floodways;
- To permit development with a lower sensitivity to the flood hazard to be located within the floodplain, subject to appropriate design and siting controls;
- To ensure that development should not detrimentally increase the potential flood affectation on other development or properties either individually or in combination with the cumulative impact of development that is likely to occur in the same floodplain; and
- To ensure that development does not prejudice the economic viability of any Voluntary Acquisition Scheme.

4.2. Previous studies

Several previous studies and assessments have been completed in support of a number of developments on adjacent to the subject site and the Georges River. A summary of the scope and findings of these assessments is provided below.

4.2.1 Georges River Flood Study (UNSW, 1991)

In 1991, the Water Research Laboratory of the University of New South Wales (UNSW) completed the *Georges River Flood Study* (Flood Study) on behalf of the NSW Department of Public Works.

This Flood Study (UNSW, 1991) investigated flood levels for a number of design flood events at locations along the Georges River between Liverpool Weir, the Hume Highway and Picnic Point. As part of the flood study, hydrologic and hydraulic modelling was completed to define the floodplain and level of flood affectation in the catchment. A physical model was prepared to determine peak flood height data throughout the study area.

As part of the Flood Study (UNSW, 1991), an assessment of an Extreme Flood Event was completed to determine the impacts generated during a potential 'worst case' flood. It is noted that at the time, a generalised procedure for estimating an Extreme Flood Event (EFE) was not available for the Georges River catchment. As such, the temporal pattern and procedure adopted for the EFE estimation were based on generalised tropical storms for Queensland.

Results of the hydraulic modelling completed as part of the Flood Study (UNSW, 1991) indicated that the tropical storm EFE was highly uniform, resembling a pulse input. Furthermore, peak flows at the Liverpool weir during a 12-hour and 36-hour EFE were 4,807 m^3/s and 3,407 m^3/s respectively. Results indicated that the larger volume of runoff generated in the 36-hour event provided maximum flood levels and therefore, the 36-hour EFE was adopted as the peak flood event for the catchment.

4.2.2 Georges River Floodplain Risk Management Study and Plan (Bewsher Consulting, 2004)

In 2004, Bewsher Consulting completed the Georges River Floodplain Risk Management Study and Plan (FRMSP), which investigated the flood behaviour within the Georges River to inform potential floodplain management measures and recommended planning controls to manage flood risk within the catchment.

The Georges River FRMSP built upon the modelling, findings and recommendations of the Georges River Flood Study (UNSW, 1991) to incorporate a larger study area and to upgrade the Georges River hydraulic model from a physical model to a one-dimensional hydraulic computer model (MIKE-11).

The Georges River MIKE-11 model consolidated various separate MIKE-11 models, which were previously developed for different segments of the Georges River into a single model for the catchment. It is noted that at the Liverpool Weir, the peak flow during the 5% AEP and 1% AEP events in the MIKE-11 model is 1,330 m^3/s and 1,740 m^3/s respectively.

4.2.3 Liverpool CBD Floodplain Management Study Report (GHD, 2007)

In 2007, GHD completed the *Liverpool CBD Floodplain Management Study* on behalf of Council. This study investigated the behaviour of overland flooding within the Liverpool Central Business District and the capacity of the existing drainage network within the catchment.

As part of the study, *DRAINS* modelling was completed of the drainage network and overland flowpaths within the catchment to identify high hazard areas where properties or individuals are at greatest risk of overland flooding. Importantly, the drainage network within the Liverpool CBD discharges at two (2) locations into the Georges River near the northern boundary of the Moore Point precinct. Refer to **Plate 4-1**.

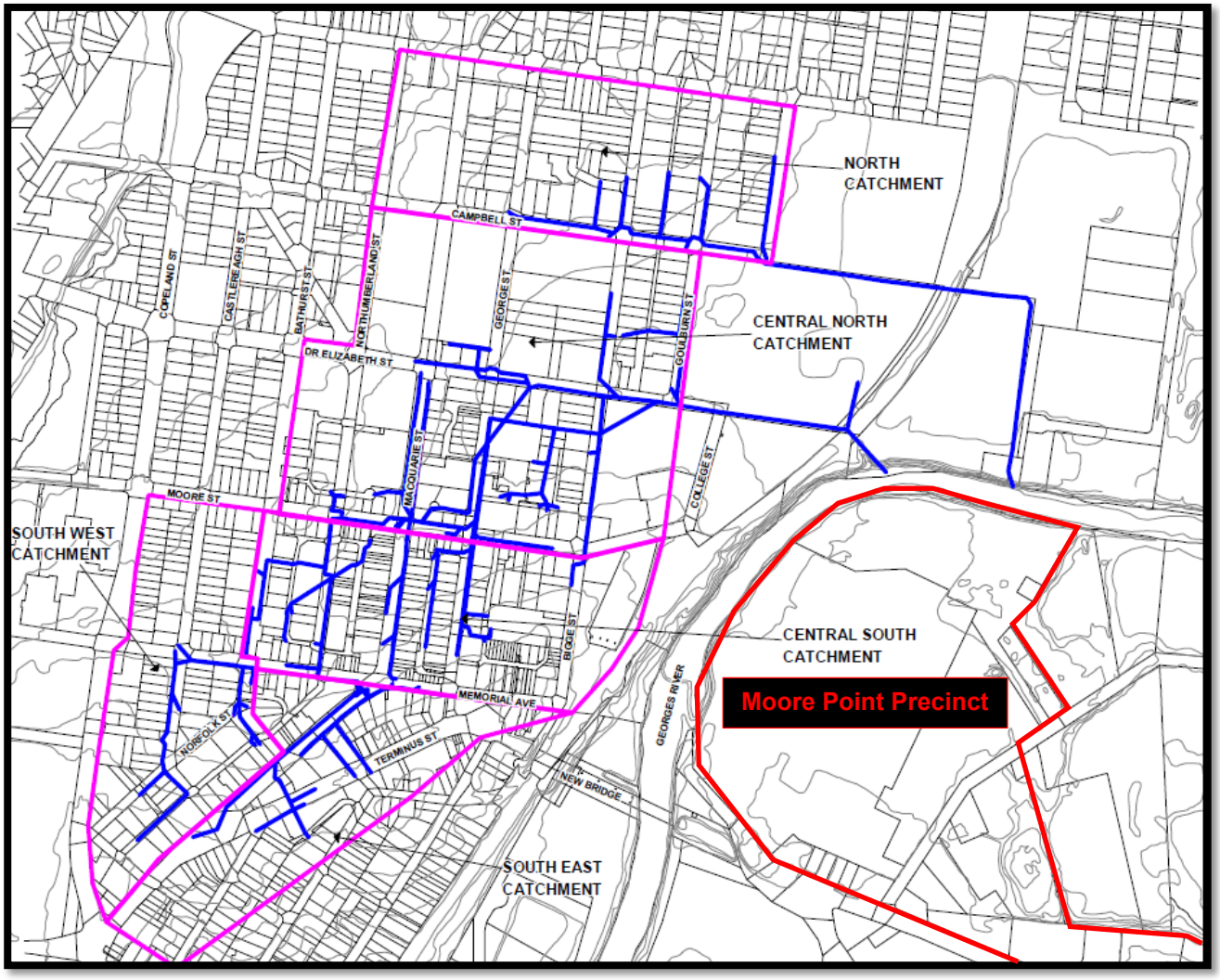

Plate 4-1 Drainage network (GHD, 2007)

4.2.4 Moorebank Georges River precinct investigation – Flood constraints advice (Calibre Consulting, 2016)

In 2016, Calibre Consulting completed the *Moorebank Georges River Precinct Investigation – Flood Constraints Advice* on behalf of Council. This investigation was prepared to inform the master planning processes for the urban renewal of the 'Moorebank precinct' which includes the Moore Point precinct.

As part of the investigation, a high-level floodplain reclamation strategy was developed to determine areas where earthworks may be suitable to accommodate future development in the area while providing a balance in floodplain storage. Based on the high-level calculations, 140,000 m^3 of additional flood storage would be available if this strategy was implemented. Refer to **Plate 4-2**.

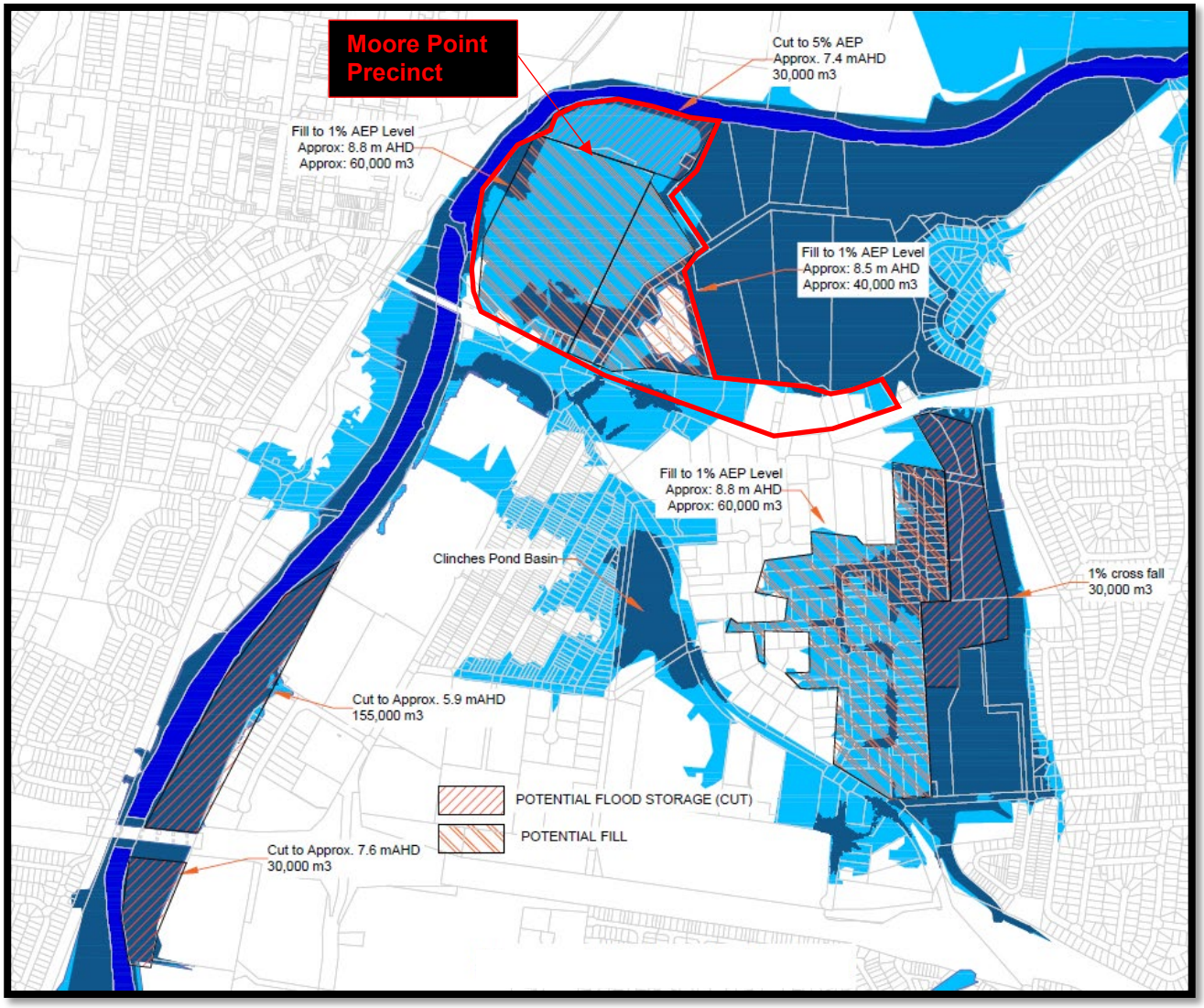

Plate 4-2 Moorebank Precinct Regional Floodplain Reclamation Strategy

In addition, a concept basin strategy was prepared that identified potential locations for detention storage and water quality treatment for the Moorebank precinct. This strategy proposed for detention storage to be provided in conjunction with water quality treatment at strategic locations throughout the Moorebank precinct. Indicative sizes of the proposed stormwater management measures were prepared based on a rate of 330 m^3/ha (for detention storage) and 1% of the catchment area (bio-retention raingarden filter area). Refer to **Plate 4-3** for the indicative sizes and locations of the stormwater management measures proposed in the regional strategy.

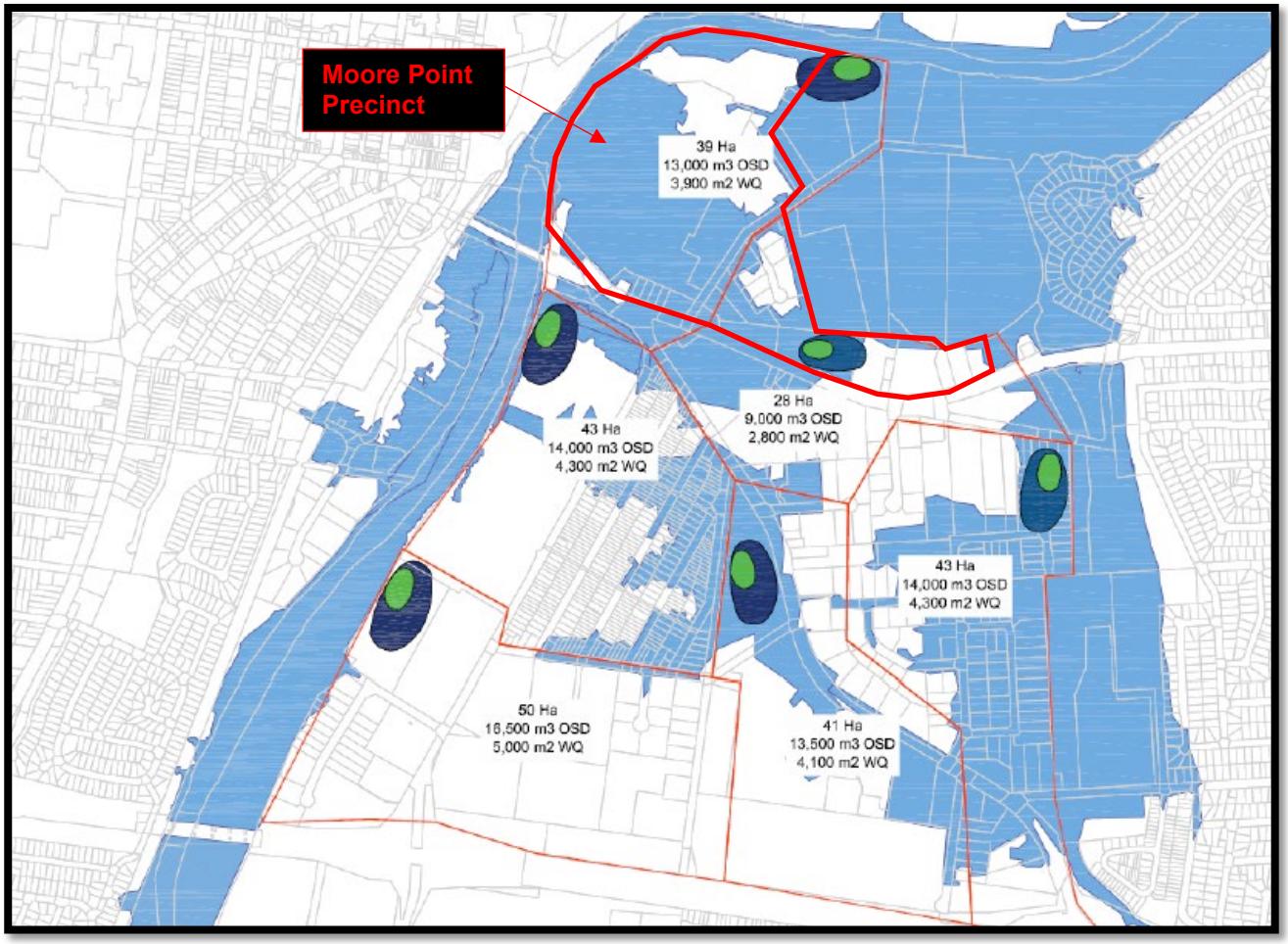

Plate 4-3 Moorebank precinct regional basin strategy

4.2.5 Assessment of regional floodplain reclamation strategy (J. Wyndham Prince, 2016)

To inform an early planning proposal for the Moore Point precinct, J. Wyndham Prince completed a preliminary flood assessment that included the proposed reclamation strategy for the Moorebank precinct detailed in the Calibre report (refer to **Section 4.3.4**).

Results of the preliminary flood assessment indicated that with the proposed fill areas within the Moore Point precinct, flood levels within the Georges River increased by up to 70 mm in the vicinity of the Liverpool Weir due to reduced waterway area. Notwithstanding, the proposed cut areas located along the Georges River did provide additional floodplain storage, with flood levels in the vicinity of these areas reducing by up to 20 mm.

Given the focus of this 2016 assessment was the Moore Point precinct, the regional floodplain reclamation strategy has not been assessed. Local cut and fill assessment have formed part of this assessment with further details in **Section 6.4**.

4.2.6 Liverpool Waterfront, Liverpool – Flora and Fauna Assessment (ELA, 2016)

In 2016, ELA completed the *Liverpool Waterfront, Liverpool Flora and* Fauna *Assessment.*

The findings and recommendations of the assessment are as follows:

- Two (2) native vegetation communities listed as Endangered Ecological Communities (EEC's) under the *Threatened Species Conservation Act 1999* were identified on the precinct*;*
- Based on the proposed masterplan, the majority of potential habitat for threatened species of fauna will be avoided;

- Assessments of significance of a number of fauna species may be required at the Development Application stage. However, it is unlikely that the impacts of the proposed development will be deemed significant;
- Upon completion of the masterplan, a formal impact assessment will be required which will include the mitigation measures that are to be adopted as part of the proposed development; and
- The Georges River is a 4th order stream and therefore a controlled activity approval will be required by the Department of Primary Industries Water should works be proposed within 40 m of the riverbanks.

4.2.7 Proposed development – 6-8 &16 Bridges Road, 361 Newbridge Road Moorebank Stormwater Management Strategy and Flood Impact Assessment (Northrop, 2015)

In 2015, Northrop prepared a proposed stormwater management strategy and flood impact assessment/management report for Coronation Property Co. The report describes the considerations that have been made as a part of the flood impact assessment to supplement the rezoning application and respond to Council's requirements for stormwater management.

The report addressed the NSW Department of Planning and Environment Section 117 Direction, Clause 4.3 Flood Prone Land. It demonstrated that development of the land can proceed in a manner which will not cause increased flooding either on or off the site. It also demonstrated that residents of the proposed development will be protected from the effects of flooding and can safely remain on site during a flood or evacuate along Anchor Place through 361 Newbridge Road The flood impact study was undertaken by Hydrostorm Consulting for Coronation Property Co/Northrop. This study was mentioned in the report stating that a neutral to positive flood impact resulted from the proposed development.

The report states that on-site stormwater detention is not deemed necessary for the proposed development and the stormwater system within the development site would be sized for a 0.2 EY (Exceedance Year) storm frequency, with overland flows catering for a 1% AEP storm.

4.2.8 Anzac Creek Floodplain Risk Management Study and Plan (BMT, 2008)

BMT completed the Anzac Creek Floodplain Risk Management Study and Plan (FRMSP) in 2008 for Council. The objectives of the Anzac Creek Floodplain Risk Management Study were to identify and assess measures for the mitigation of existing flood risk, Identify and assess planning and development controls to reduce future flood risks and present a recommended floodplain management plan that outlines the best possible measures to reduce flood damages in the Anzac Creek catchment. The flood risk categorisation has been adopted in this study to identify relative risk within the catchment and to guide planning controls appropriate for the different flood risk categories. The flood risk map is shown in **Plate 4-4**.

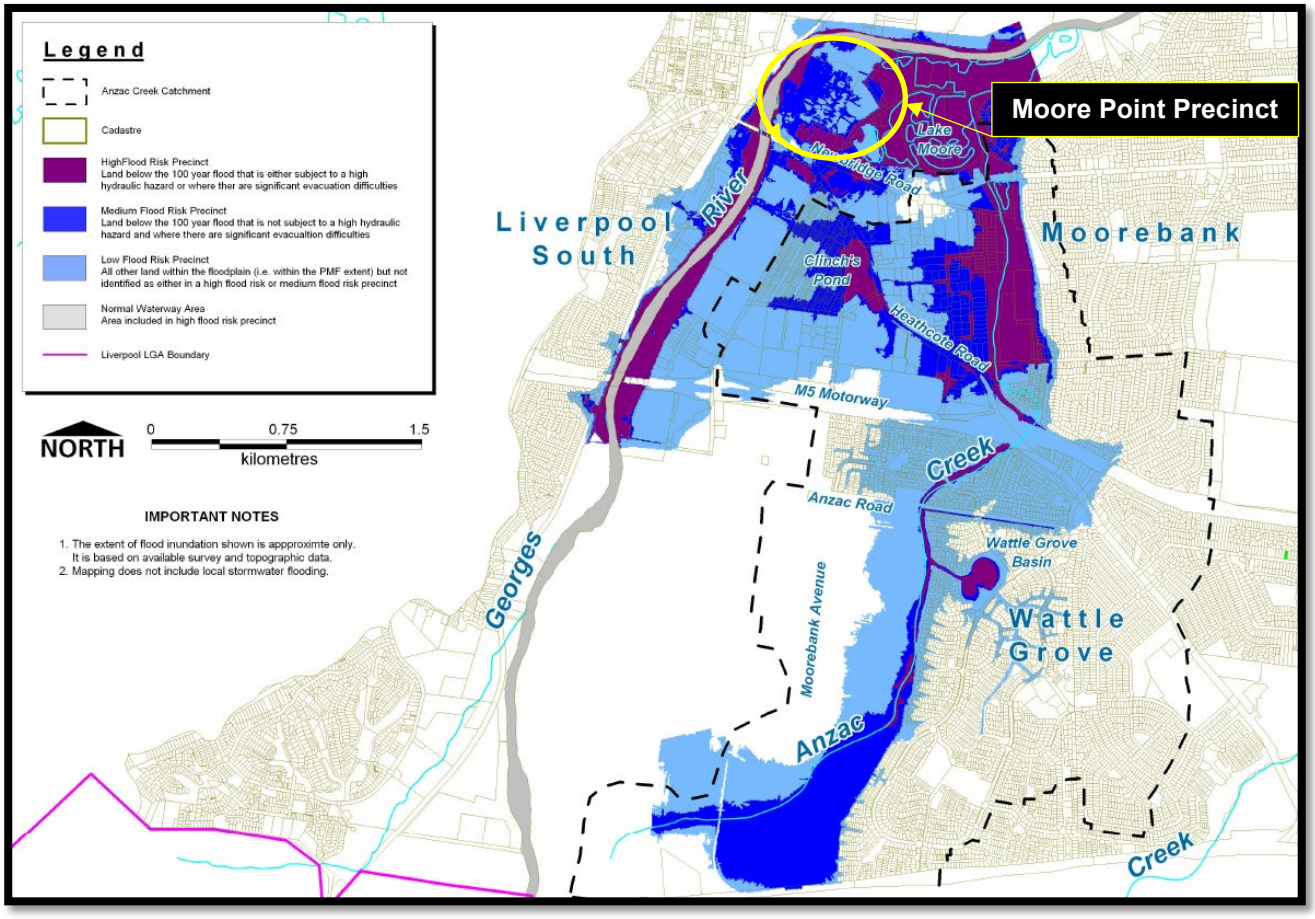

Plate 4-4 Anzac Creek Catchment Flood Risk Map (Anzac Creek FRMSP, BMT 2008)

The Anzac Creek Floodplain Management Study considered and assessed several floodplain management measures among them was Georges River Levee near the proposed Moore Point precinct. This option included levee at two (2) breakouts from the right bank of the Georges River just upstream of Newbridge Road. The results showed that levee would be effective in eliminating these spills from the Georges River in this location, however, the net effect on flood levels in the Anzac Creek catchment was negligible given the backwater influence of the Georges River on flood conditions in this lower part of the Anzac Creek catchment which resulted in this levee being not a viable mitigation option.

Nevertheless, this study incorporated the mitigation option of having levee at one breakout close to the development site from the right bank of the Georges River just upstream of Newbridge Road.

4.2.9 Liverpool Waterfront Water Cycle and Flood management Strategy (JWP, 2016)

J. Wyndham Prince prepared Water Cycle and Flood Management Strategy for Liverpool Waterfront to inform the early proposed planning and support the rezoning submission to the Council. The assessment concluded that the stormwater detention is not required for the precinct as the development site provides only 0.1% of the total peak flow in the Georges River and therefore, any changes to the characteristics of the precinct as a result of the development will unlikely impact the flow regime of the Georges River. In addition, the proposed development landform and regional floodplain reclamation strategy had resulted in an increase in the available floodplain storage by 123,500 m3 with no increase in flood level as compared to “existing” conditions in the catchment in the 5% and 1% AEP events.

The strategy recommended the stormwater quality management measures for the Liverpool Waterfront comprising treatment train that included on-lot treatment (rainwater tanks), street-level treatment (GPTs) and subdivision/development treatment measures (bio-retention raingardens).

Flood evacuation routes for the Moore Point Precinct were identified to be Newbridge Road to the south of the precinct and use of the proposed pedestrian bridges linking the precinct to the Liverpool CBD would provide additional early flood evacuation routes during an Extreme Flood Event.

4.2.10 Georges River Flood Study (BMT, 2019)

BMT Group undertook the review and updated the Georges River Flood Study for Liverpool City Council and Canterbury Bankstown Council. The objective of the study was to provide Council with accurate flood mapping and descriptions of the behaviour of floods along the Georges River, using the latest data and modelling techniques to facilitate Council's management of flood risks within the study area. The study provided a basis for flood-related development controls in relation to potential future development on the Georges River floodplain, following rigorous analysis and consultation with key stakeholders. The design flood inundation extents are shown in **Plate 4-4**.

A TUFLOW HPC hydraulic model was developed for the study area, the latest available topographical data and the most up-to-date river cross-sections. The runoff inflows to the hydraulic model were applied from previously adopted rainfall-runoff modelling utilising ARR 1987 procedures from the Georges River Floodplain Risk Management Study (Bewsher Consulting, 2004) to maintain a general consistency with existing flood planning levels.

The TUFLOW flood model was calibrated and validated to historic flood data collected in the August 1986, April 1988, April 2015 and June 2016 flood events, based on an analysis of hydrologic records and historical flows at Liverpool Weir. The model calibration results indicated that the developed TUFLOW flood model provided a reasonable representation of the catchment flood response. Hence, the model parameters adopted for the model calibration and validation events were adopted for design event simulation.

The report states that the developed 2D TUFLOW hydraulic model provides Council with a sophisticated modelling tool for flood impact assessment of potential future developments on the floodplain. As such, the flood model from this study forms the basis of the hydraulic model for the proposed Moore Point precinct at Moorebank.

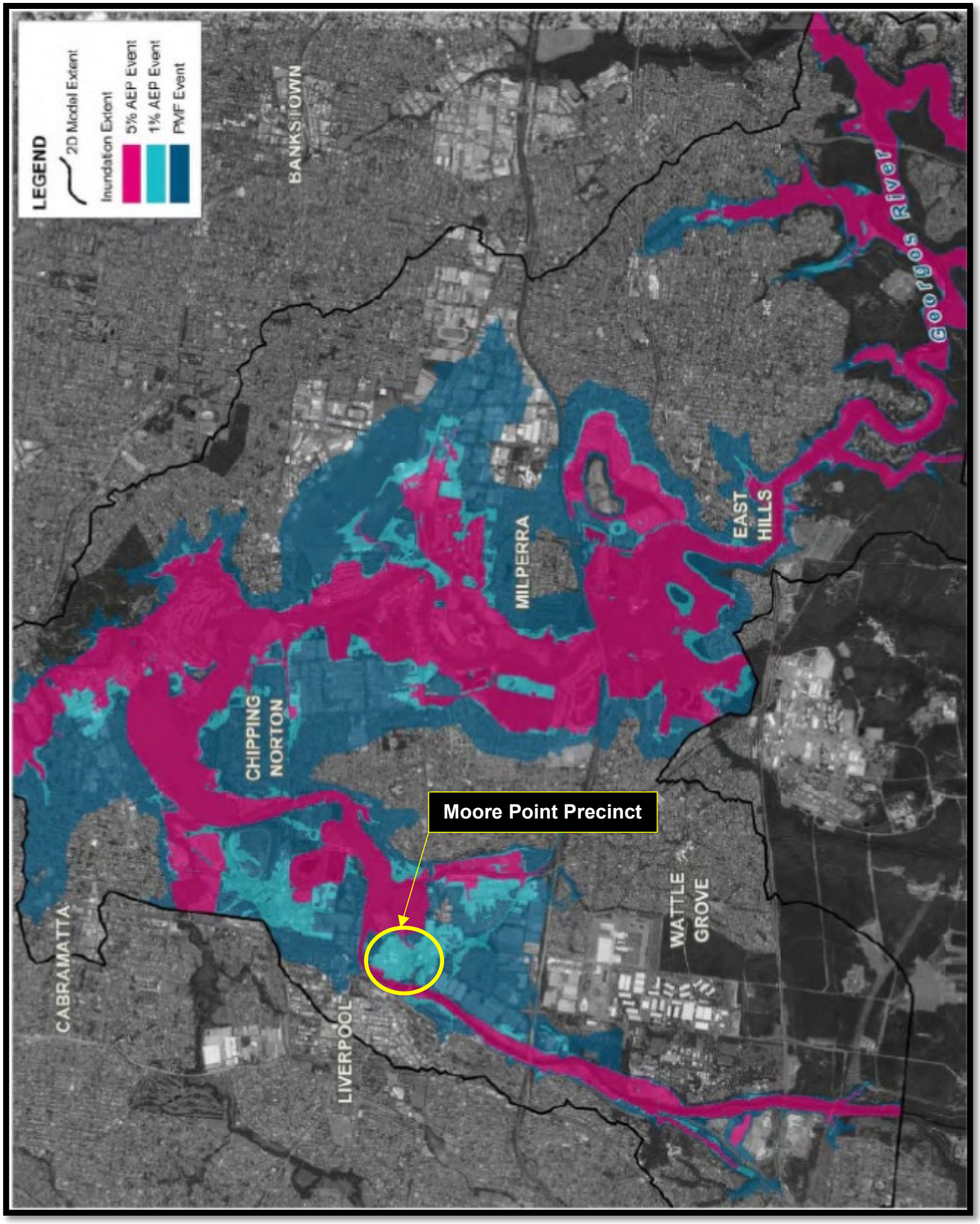

Plate 4-5 Design flood inundation extents (Georges River Flood Study BMT, 2019)

5. FLOOD MODELLING ASSESSMENT

5.1. Available data

The following data was used to inform the current hydraulic assessment:

- Hydrology/hydraulic model inputs from Councils currently adopted regional flood model for the Georges River (BMT 2019);
- Ground survey of the site; and
- Precinct masterplan.

5.2. Modelling approach

In order to assess the flood behaviour of the site, the existing TUFLOW 1D/2D floodplain model was provided by Council and developed for the Georges River Flood Study (BMT, 2019). This has been used as the basis of this assessment. All parameters have been adopted from Council's provided model unless otherwise specified.

Two (2) model scenarios for 1% AEP and Probable Maximum Flood (PMF) storm events have been assessed to represent the catchment conditions likely to have the greatest influence on flooding within the catchment. These scenarios allowed for the assessment to consider the current and future conditions of the precinct. The model scenarios are as follows:

- Current 'existing' conditions
- Future 'developed' conditions

The "existing" conditions assessment considers the current topography of the precinct and catchment. This includes the current industrial uses on the precinct as well as the highly urbanised catchment within the Moorebank area.

The 'developed' conditions assessment considers the proposed development landform (preliminary design) and a proposed levee/restriction along the Georges River.

5.2.1 Model domain extent

The model domain for this study extends from Cambridge Avenue to Governor Macquarie Drive. The Flood Study 2019 model is cut down at Governor Macquarie Drive defining the downstream boundary of the model for this study. The upstream boundary is kept consistent with the 2019 flood model. A map showing the main features adopted in the TUFLOW model is illustrated in **Figure 5-1**.

5.2.2 Grid size

The Flood Study 2019 had adopted the cell size of 10 m which may have reduced the actual conveyance within the Georges River. Notwithstanding this possible limitation, a 10 m size for the scale of the model is appropriate. The cell sizes of 2D domains need to be appropriately sized to reproduce the hydraulic behaviour and provide accurate results in order to complete an appropriate flood impact assessment for this precinct. As such, the TUFLOW model for this study has adopted the cell size of 2.5 m x 2.5 m which is four (4) time smaller than the original model. This will ensure an accurate representation of the hydraulic behaviour surrounding the precinct as a result of the proposed works.

It is noted that TUFLOW 2020 has been released with TUFLOW HPC which now supports variable cell sizes within the same model using a quadtree mesh. The benefits include much improved hydraulic modelling outcomes and includes a major advantage in the way open channels are modelled.

This analysis could be integrated into the larger Georges River hydraulic modelling completed by Council (if required) and would deliver a single hydraulic assessment that focuses on a refined modelling outcome surrounding the Moore Point development.

5.2.3 Terrain

In addition to the underlying Digital Terrain Model (DTM) provided as part of Council's model, the following amendments have been undertaken to supplement the modelling in the vicinity of the site.

- Detail ground survey;
- Ensure representative terrain within the Georges River. The levels of the river centre line have been defined based on the available bathymetry survey; and
- Terrain modification to ensure the embankment of the Georges River adjacent to the precinct is accurately defined. The embankment levels (via a Z line) have been modified based on the level information contained in the Georges River flood model.

Under 'developed' conditions, the DTM within the Moore Point precinct was updated to incorporate proposed development cut and fill within the precinct and a levee at the right banks of the Georges River near Newbridge Road.

5.2.4 Hydrology

The majority of the precinct drains east towards Lake Moore, with a portion of the precinct to the west and north discharging directly into the Georges River. The 40 ha precinct forms 0.04% of the overall Georges River catchment of 96,000 ha.

Given the industrial nature of the existing precinct, which is effectively impervious and relatively small in size, there was no significant change in the runoff characteristics for the site between existing and developed conditions. The catchment size, slope and percentage impervious are similar enough not to cause significant impact to the peak flows within the Georges River.

5.2.5 Flows and upstream boundary conditions

Flow hydrographs extracted from the hydrological model have been applied to represent flows entering the model from both local and upstream catchments. The upstream boundary flow and local flow hydrographs were applied as a 'source area' (SA) input consistent with Council's original 2019 model.

5.2.6 Downstream boundary conditions

The water level time series (height vs time) is adopted at Governor Macquarie Drive as the downstream boundary condition for this model. The water level time series at this location is extracted from the broader 2019 George River flood model for each modelled storm event.

5.2.7 Material roughness

Material roughness parameters were refined to represent the current land use with the precinct but were generally kept consistent with Council's 2019 Model.

5.2.8 Initial water level

To account for antecedent rainfall in the catchment, the model was filled to RL 2.91 m AHD consistent with Council's model.

6. FLOOD MODELLING RESULTS

J. Wyndham Prince has assessed the flood behaviour for the 1% AEP and PMF storm events under existing and developed conditions. The flood depth, level and extent mapping for existing and developed conditions are shown in **Figures 6.1 – 6.8** in **Appendix A**.

6.1.1 Flood behaviour under existing conditions

During the 1% AEP event, mainstream flows breach the eastern banks of the Georges River adjoining the western precinct boundary. These flows are then conveyed through the precinct, resulting in ponding depths of up to 2 m within the precinct (see **Figure 6.3** for details). The flood levels across the precinct range from 9.2 m AHD (in the western corner of the precinct) to 8.4 m AHD (along the eastern, northern and southern precinct boundary).

Furthermore, mainstream flows in the Georges River also breach the riverbanks to the south of the precinct, with flows conveyed east towards an existing low point near the Heathcote and Newbridge Road intersection. These flows then combine with local overland flows from the Moorebank area before being conveyed along Bridges Road towards Lake Moore. It is noted that the ponding occurring on the precinct near the intersection of Bridges Road and Newbridge Road are up to 1.2 m as a result of the combined overland and mainstream flows.

During the PMF, mainstream flows breach the banks of the Georges River adjoining both the western and northern precinct boundaries. It is noted that due to the significant flow rate in the PMF, which is approximately 3,400 m^3/s, the depth of ponding on the precinct ranges up to 6 m, with the entire precinct being inundated by mainstream flooding of 12.4 m AHD.

The 1% AEP and PMF storm event existing condition flood level, extent and depth are shown in **Figures 6.1** to **6.4** in **Appendix A**.

6.1.2 Flood behaviour underdeveloped conditions

The 1% AEP storm event result for the developed condition shows that the peak flood level at the Georges River is 9.2 m AHD with no breach of the riverbank; leaving the Moore Point precinct unaffected from flood event up to 1% AEP. The proposed development cut and fill within the precinct prevented the breakout flows from entering the precinct along the western precinct boundary. In addition, the provision of the flood control/levee to the south of Newbridge Road averts mainstream flows from breaching the banks of the Georges River during the 1% AEP event. This restriction of breakout flows from breaching the Georges River prevented the flood affectation to the properties south of the Newbridge Road in 1% AEP storm event. The 'green' area on this figure provide considerable regional benefits and results in no flooding at Newbridge Road and Bridges Road intersection (see **Figure 6.9** for the flood impact assessment).

However, during the PMF event, the level of flood affectation on the precinct is similar to 'existing' conditions of 12.4 m AHD, with mainstream flows breaching the banks of the Georges River and inundating the precinct.

The 1% AEP and PMF storm event developed condition flood level, extent and depth are shown in **Figure 6.5** to **6.8** in **Appendix A**.

6.2. Impact assessment

The impact of the Moore Point precinct on flooding was assessed by comparing the peak flood levels under existing and developed conditions. The assessed peak flood level differences under the 1% AEP event is shown in **Figure 6.9** in **Appendix A**. As a result of the Moore Point precinct, localised increase in flood levels of up to 0.20 m occur along the northern fringe of the development during the 1% AEP event along with minor localised increase in flood level of less than 25 mm with an extent of 950 m along the Georges River in the vicinity of the proposed levee.

However, the 1% AEP flood impact results demonstrated that there are no adverse flood impacts to the neighbouring properties as a result of the Moore Point precinct. In addition, the development has provided regional flood immunity benefits to the properties south of precinct and on Newbridge and Bridges Roads.

6.3. Flood planning level

The 1% AEP peak flood level in the Georges River is 9.2 m AHD in the vicinity of the precinct in the developed condition. Council's development control plan (DCP) requires the residential and industrial/commercial development to have habitable floor level to be no lower than1% AEP flood level plus 0.5 m freeboard. The flood planning level for the precinct would therefore be 9.7 m AHD. Hence, it is noted that as part of the development approval process, appropriate floor level controls will be adopted for each of the proposed buildings and as such will deliver Council's flood planning objective.

6.4. Floodplain storage

Current development controls outlined in the Liverpool DCP (LCC, 2008), do not permit filling within the 1% AEP flood unless compensatory excavation (cut) is proposed to ensure no net loss of floodplain storage. To determine the change in floodplain storage due to the proposed filling on the precinct, storage calculations were completed using the digital terrain models adopted in the flood modelling and the flood model results prepared for 'existing' conditions.

As the Moore Point precinct is part of the overall Moorebank precinct, compensatory cut areas are provided near Helles Park and Titalka Park nearly 1200 m and 1700 m upstream of the precinct respectively. The location of the proposed compensatory cut is provided in **Plate 6-1**. These compensatory cut areas will form part of the required works necessary to support the development of the precinct. The floodplain approach is also consistent with the regional floodplain reclamation strategy for the Georges River prepared by Calibre Consulting in 2016.

Plate 6-1 Proposed compensatory cut area location

Results of the floodplain storage calculations for the precinct are provided in **Table 6-1**.

Table 6-1 – Floodplain storage

Available storage volume:	**1%AEP**
Existing conditions – Site	98,000 m³
Developed Conditions - Site	24,000 m³
Developed Conditions – Regional Near Helles Park	39,700 m³
Developed Conditions – Regional Near Titalka Park	66,280 m³
Change in Floodplain storage	31,980 m³

The floodplain storage calculations demonstrate that the proposed compensatory cut on the precinct and regional cut areas along the Georges River provides an excess of floodplain storage of 31,980 m^3. Notwithstanding, the proposed development will not generate any adverse impacts on flood levels within surrounding properties or within the Georges River. Refer **Section 6.2** for further details.

It should be noted that the flood modelling for the developed condition assessment did not include the proposed regional compensatory cut areas. Thus, the flood impact is considered to be conservative while provided suitable flood outcomes. Further refinement of the floodplain storage areas and flood assessments will form part of future development applications.

6.5. Flood Prone Land

As discussed above the precinct is partially inundated by mainstream flooding in 1% AEP event, were flows breach the banks of the Georges River and enter the site. However, this assessment has shown that with the implementation of the mitigation measures, the proposed development can safely occupy the floodplain within minimal impact and be development consistent with principals outlines the NSW Government's Floodplain Development Manual 2005.

Therefore, the flood management regimes for the Moore Point development are consistent with Section 9.1 Directions issued by the NSW Government back on 1 July 2009 and specifically address the consistency requirements of Direction 4.3 – Flood Prone Land detailed in these directions as the principal of the Floodplain Development Manual 2005 have formed an integral part of all assessments.

7. GLOSSARY

Term	Definition
Airborne Laser Survey (ALS)	Is a technique for obtaining a definition of the surface elevation (ground, buildings, power lines, trees, etc.) by pulsing a laser beam at the ground from an airborne vehicle (generally a plane) and measuring the time taken for the laser beam to return to a scanning device fixed to the plane. The time taken is a measure of the distance which, when ground-truthed, is generally accurate to ± 150mm.
Annual Exceedance Probability (AEP)	The chance or probability of a natural hazard event (usually a rainfall or flooding event) occurring annually. Normally expressed as a percentage.
Australian Rainfall and Runoff (AR&R)	Refers to the current edition of Australian Rainfall and Runoff published by the Institution of Engineers, Australia.
Dam Crest Flood (DCF)	The flood event where a dam embankment is first overtopped.
Dam Safety Committee (DSC)	A NSW statutory body aligned with Department of Primary Industries. Its function is to ensure the safety of dams within NSW.
Digital Terrain Model (DTM)	Is a spatially referenced three-dimensional (3D) representation of the ground surface represented as discrete point elevations where each cell in the grid represents an elevation above an established datum.
Exceedances per Year (EY)	The number of times a year that statistically a storm flow is exceeded.
Floodplain Planning Level (FPL)	The FPL is a height used to set floor levels for property development in flood-prone areas. It is generally defined as the 1% AEP flood level plus 0.5m freeboard.
Floodplain Development Manual (FDM) and Guidelines (April 2005)	The FDM is a document issued by the Department of Environment Climate Change and Water (DECCW) that provides a strategic approach to floodplain management. The guidelines have been issued by the NSW Department of Planning (DoP) to clarify issues regarding the setting of FPL's. This document is also the framework for the development of Floodplain Risk Management Studies and Plans.
Floodplain Storage Areas	Parts of a floodplain that are important for the temporary storage of floodwaters during the passage of a flood. Loss of flood storage can increase the severity of flood impacts by reducing natural flood attenuation.
Floodway	The areas of the floodplain where a significant discharge of water occurs during floods. They are often aligned with naturally defined channels. Floodways are areas that even if only partially blocked, would cause a significant redistribution of flood flow, or a significant increase in flood levels.
Hyetograph	The distribution of rainfall over time.
Hydrograph	Is a graph that shows how the stormwater discharge changes with time at any particular location.

Term	Definition
Hydrology	The term given to the study of the rainfall and runoff process as it relates to the derivation of hydrographs for given floods.
J. Wyndham Prince Pty Ltd (JWP)	Consulting Civil Infrastructure Engineers and Project Managers undertaking these investigations
MUSIC	A modelling package designed to help urban stormwater professionals visualise possible strategies to tackle urban stormwater hydrology and pollution impacts. MUSIC stands for Model for Urban Stormwater Improvement Conceptualisation and has been developed by the Cooperative Research Centre (CRC),
Peak Discharge	Is the maximum stormwater runoff that occurs during a flood event
Potential Loss of Life (PLL)	Potential Loss of Life assessment
Population at Risk (PAR)	Population at risk assessment
Probable Maximum Flood (PMF)	The greatest depth of precipitation for a given duration meteorologically possible for a given size storm area at a particular location at a particular time of the year, with no allowance made for long-term climatic trends.
Triangular Irregular Network (TIN)	A technique used in the created DTM by developing a mass of interconnected triangles. For each triangle, the ground level is defined at each of the three vertices, thereby defining a plane surface over the area of the triangle
TUFLOW	A computer program that provides two-dimensional (2D) and one dimensional (1D) solutions of the free surface flow equations to simulate flood and tidal wave propagation. It is specifically beneficial where the hydrodynamic behaviour, estuaries, rivers, floodplains and urban drainage environments have complex 2D flow patterns that would be awkward to represent using traditional 1D network models.
XP-RAFTS	Is a runoff routing model that uses the Laurenson non-linear runoff routing procedure to develop a sub catchment stormwater runoff hydrograph from either an actual event (recorded rainfall time series) or a design storm utilising Intensity-Frequency-Duration data together with dimensionless storm temporal patterns as well as standard AR&R 1987 data.

8. REFERENCES

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Calibre Consulting, 2016, *"Moorebank Georges River Precinct Investigation – Flood Constraints Advice"*, prepared for Liverpool City Council.

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J. Wyndham Prince, 2016 *"1 Heathcote Road, Moorebank Desktop Flood Study"*, prepared for LAC JV Pty Ltd.

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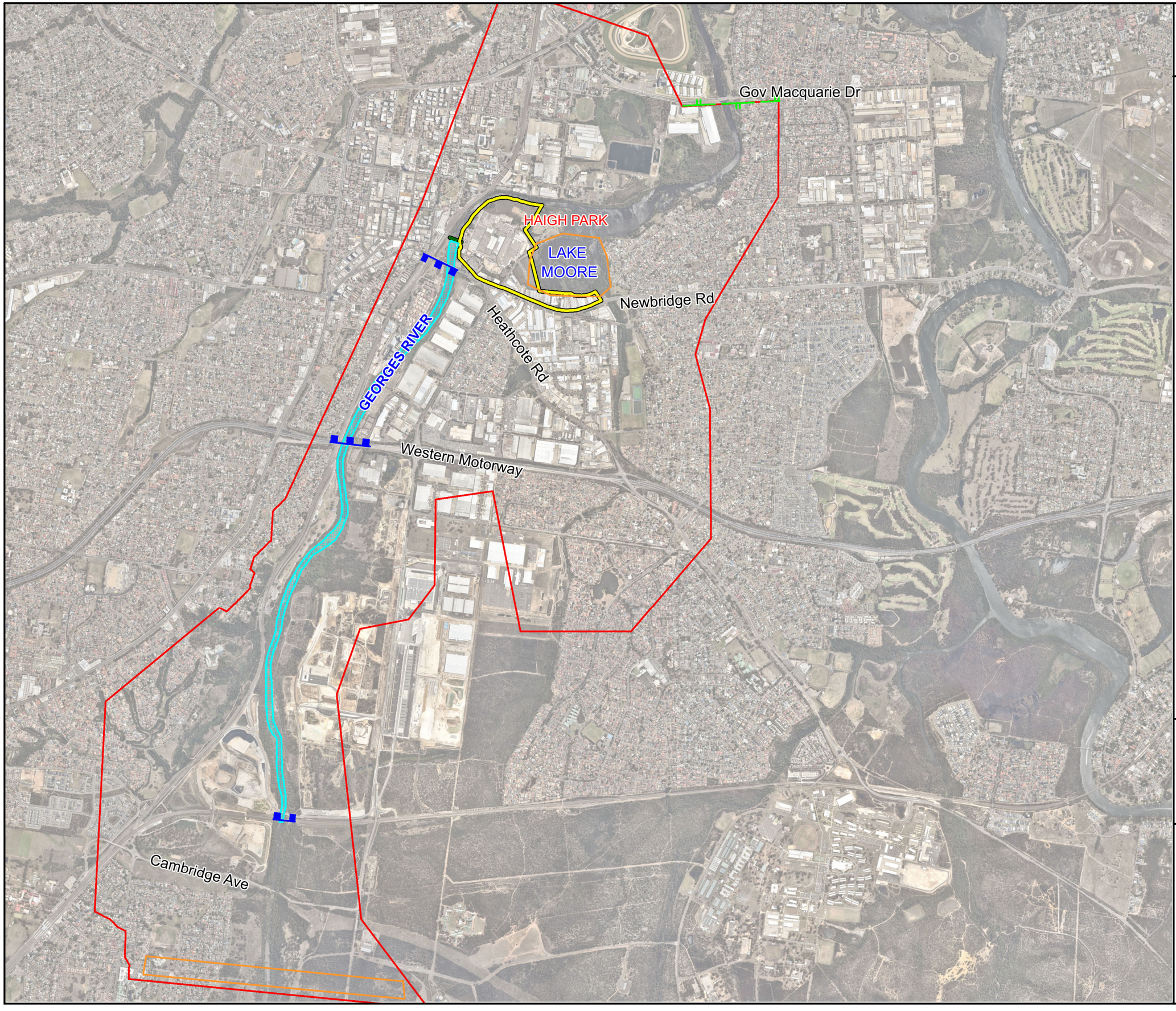
BMT, 2019 *"Georges River Flood Study",* prepared for Canterbury Bankstown and Liverpool City Council.

APPENDIX A
FLOOD MAPPING FIGURES



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& PROJECT MANAGERS

LEGEND

TUFLOW MODEL ELEMENTS

- TUFLOW Model Boundary
- Site Boundary
- SA Catchment Inflow Boundary
- IWL Initial Water Level Area
- HT Water Level Boundary
- Bridge
- Liverpool Weir

N

0 360

metres
Scale 1:9,000 @ A3

Projection: GDA 1994 MGA Zone 56

Figure - 5.1

Moore Point
Flood Impact Assessment

TUFLOW Layout

2020/03/13 A

Filename: Figure 5.1 - TUFLOW_Layout.wor

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LEGEND

- Site Boundary
- Flood Extent
- 0.2 m Flood Level Contour

N

0 80

metres
Scale 1:2,000 @ A3

Projection: GDA 1994 MGA Zone 56

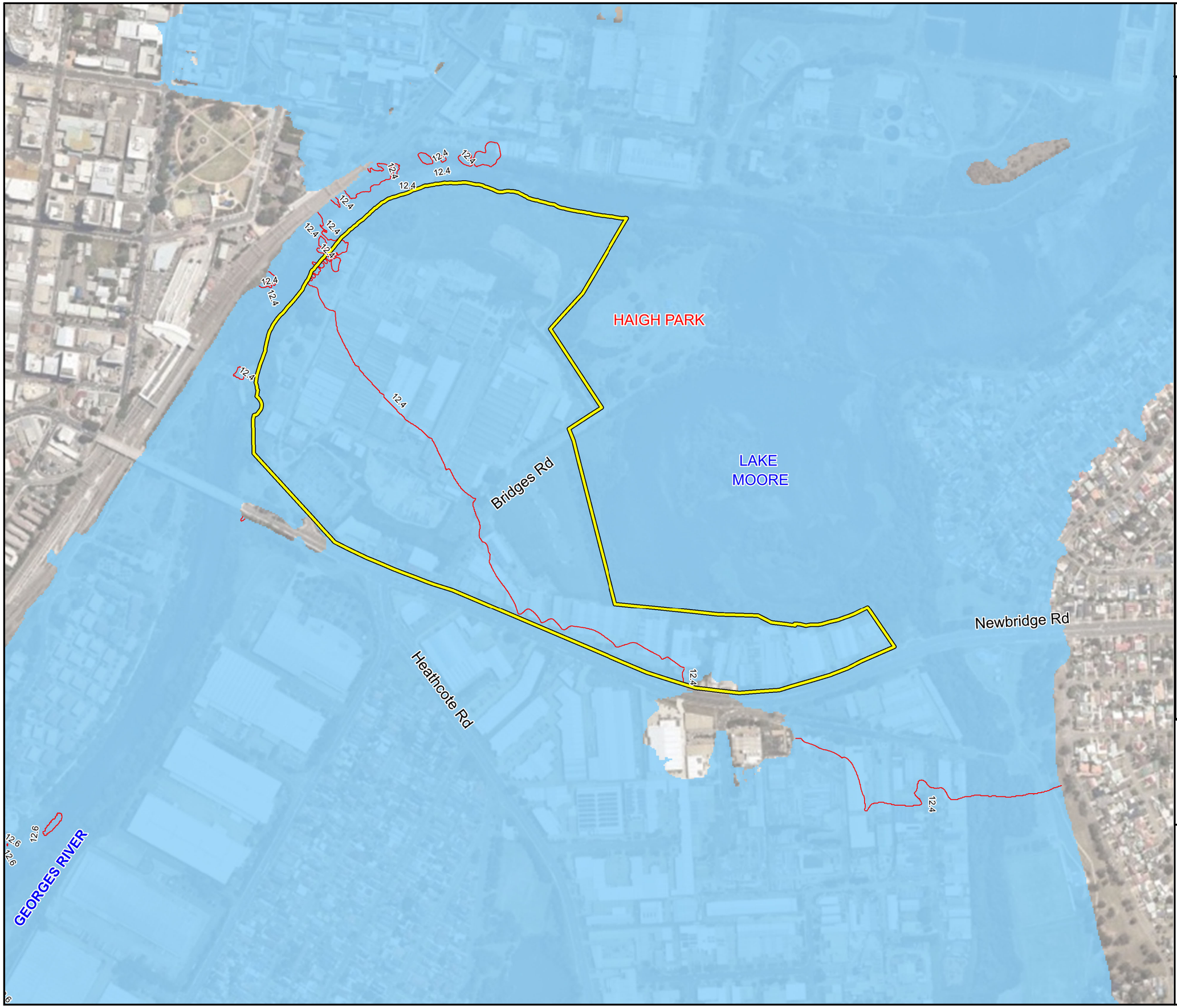
Figure - 6.1

Moore Point
Flood Impact Assessment

1% AEP Flood Levels
Existing Condition

2020/03/13 A

Filename: Figure 6.1 - 1% AEP_Existing_Flood Levels.wor



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LEGEND

- Site Boundary
- Flood Extent
- 0.2 m Flood Level Contour

N

0 80

metres
Scale 1:2,000 @ A3

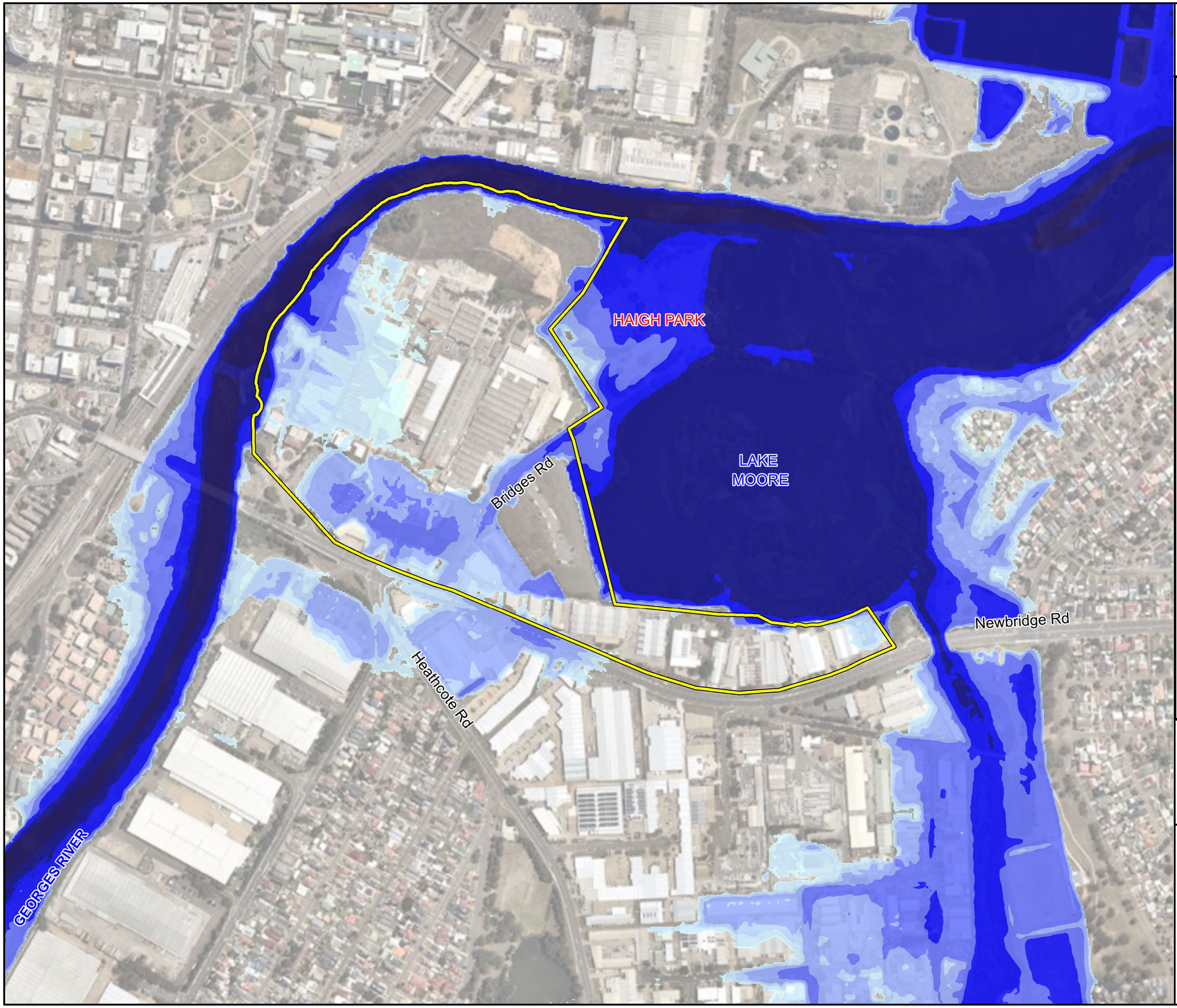
Projection: GDA 1994 MGA Zone 56

Figure - 6.2
Moore Point
Flood Impact Assessment

PMF Levels
Existing Condition

2020/03/13 A

Filename: Figure 6.1 - PMF_Existing_Flood Levels.wor



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LEGEND

FLOOD DEPTH (m)

- 0.0 to 0.1
- 0.1 to 0.3
- 0.3 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 to 5.0
- 5.0 to 10.0
- 10.0 +

Site Boundary

N

0 80

metres
Scale 1:2,000 @ A3

Projection: GDA 1994 MGA Zone 56

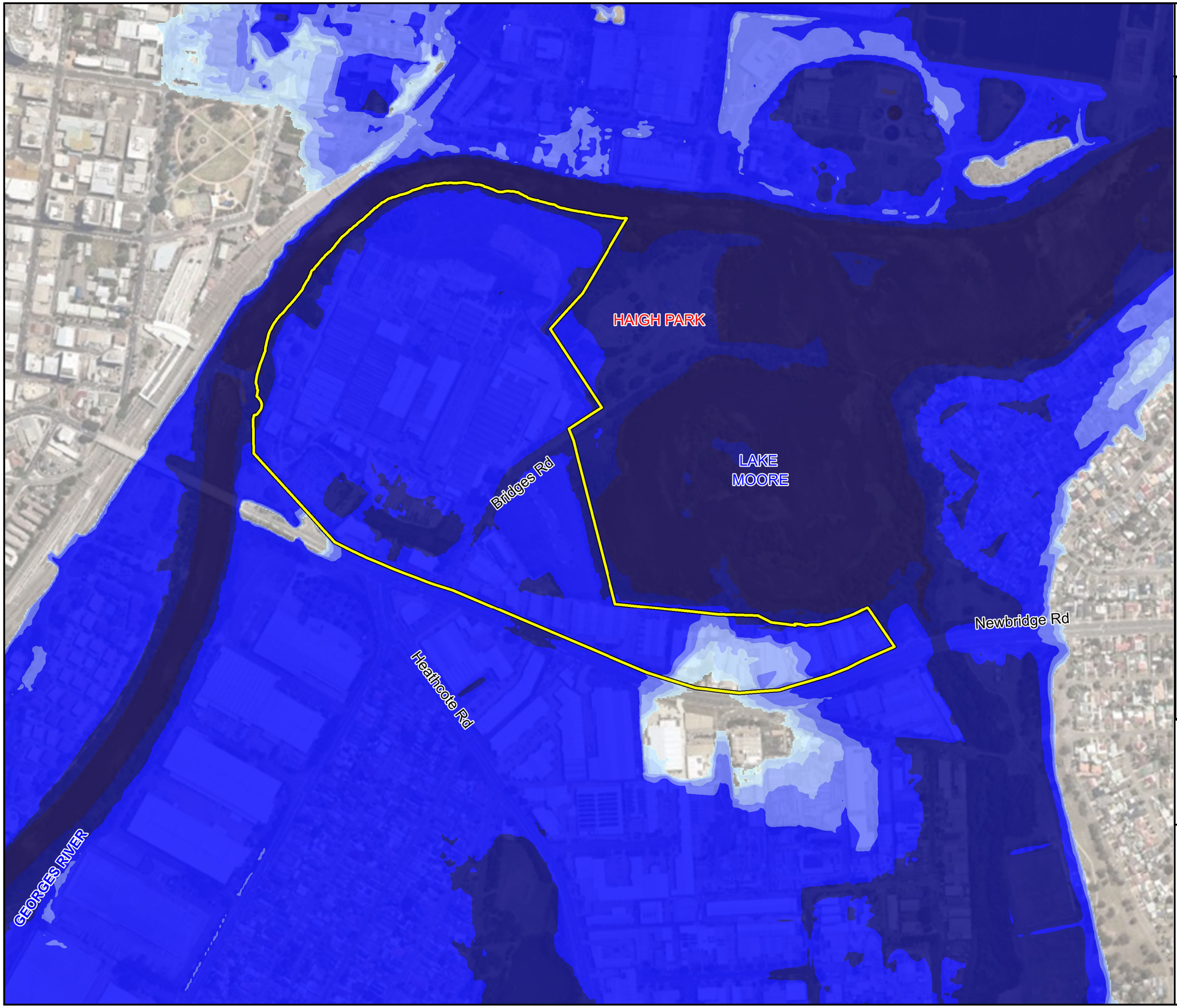
Figure - 6.3

Moore Point
Flood Impact Assessment

1% AEP Flood Depth
Existing Condition

2020/03/13 A

Filename: Figure 6.3 - 1%AEP_Existing_Flood Depths.wor



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LEGEND

FLOOD DEPTH (m)

- 0.0 to 0.1
- 0.1 to 0.3
- 0.3 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 to 5.0
- 5.0 to 10.0
- 10.0 +

Site Boundary

N

0 80

metres
Scale 1:2,000 @ A3

Projection: GDA 1994 MGA Zone 56

Figure - 6.4
Moore Point
Flood Impact Assessment

PMF Depth
Existing Condition

2020/03/13 A

Filename: Figure 6.4 - PMF_Existing_Flood Depths.wor

DRAFT

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LEGEND

- Site Boundary
- Flood Extent
- 0.2 m Flood Level Contour

Proposed Levee

HAIGH PARK

LAKE MOORE

GEORGES RIVER

Bridges Rd

Newbridge Road

Newbridge Rd

Heathcote Rd

Elizabeth Street

Bigge Park

Moore Street

Bigge Street

Scott Street

Liverpool train station

Haigh Park

Bill Morrison Park

Haigh Avenue

Lighthorse Park

McMillan Park

Moorebank Skatepark

Figure 18: movement and access structure plan

Moore Point Masterplan

N

0 80

metres

Scale 1:2,000 @ A3

1:6000 @A3

Projection: GDA 1994 MGA Zone 56

Figure - 6.5

Moore Point Flood Impact Assessment

1% AEP Flood Levels Developed Condition

2020/04/07 B

Filename: Figure 6.5 - 1%AEP_Developed_Flood Levels.wor

DRAFT

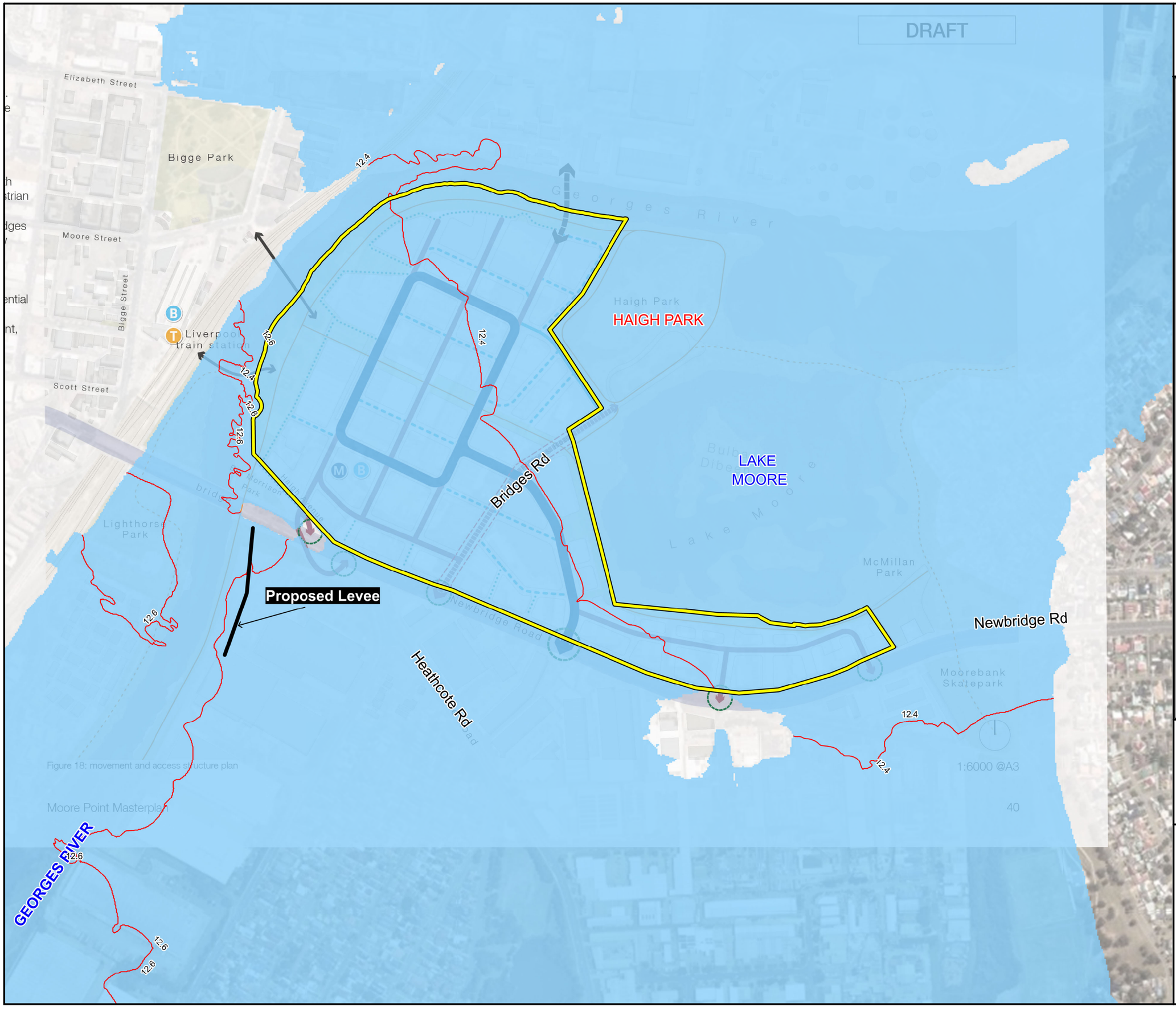

Figure 18: movement and access structure plan

Moore Point Masterplan

40

1:6000 @A3

Filename: Figure 6.6 - PMF_Developed_Flood Levels.wor

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LEGEND

- Site Boundary
- Flood Extent
- 0.2 m Flood Level Contour

N

0 80

metres
Scale 1:2,000 @ A3

Projection: GDA 1994 MGA Zone 56

Figure - 6.6

Moore Point
Flood Impact Assessment

PMF Levels
Developed Condition

2020/04/07 B

DRAFT

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LEGEND

FLOOD DEPTH (m)

- 0.0 to 0.1
- 0.1 to 0.3
- 0.3 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 to 5.0
- 5.0 to 10.0
- 10.0 +

Site Boundary

Elizabeth Street
Bigge Park
Moore Street
Bigge Street
Liverpool train station
Scott Street
Haigh Park
HAIGH PARK
LAKE MOORE
Bridges Rd
Haigh Avenue
Morrison Park
Lighthorse Park
Proposed Levee
Newbridge Road
Heathcote Rd
McMillan Park
Newbridge Rd
Mootebank Skatepark
GEORGES RIVER
Figure 18: movement and access structure plan
Moore Point Masterplan
1:6000 @A3
40

N

0 80

metres
Scale 1:2,000 @ A3

Projection: GDA 1994 MGA Zone 56

Figure - 6.7

Moore Point
Flood Impact Assessment

1% AEP Flood Depth
Developed Condition

2020/04/07 B

Filename: Figure 6.7 - 1%AEP_Developed_Flood Depths.wor

DRAFT

Elizabeth Street
Bigge Park
Moore Street
Bigge Street
Liverpool train station
Scott Street
Haigh Park
HAIGH PARK
G e o r g e s R i v e r
LAKE MOORE
L a k e M o o r e
Bridges Rd
Lighthorse Park
Bill Morrison Park
bridge
McMillan Park
Newbridge Road
Newbridge Rd
Heathcote Rd
Moorebank Skatepark
Proposed Levee
GEORGES RIVER

Figure 18: movement and access structure plan

Moore Point Masterplan

1:6000 @A3

40

Filename: Figure 6.7 - PMF_Developed_Flood Depths.wor

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LEGEND

FLOOD DEPTH (m)

- 0.0 to 0.1
- 0.1 to 0.3
- 0.3 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 to 5.0
- 5.0 to 10.0
- 10.0 +

Site Boundary

N

0 80

metres
Scale 1:2,000 @ A3

Projection: GDA 1994 MGA Zone 56

Figure - 6.8
Moore Point
Flood Impact Assessment

PMF Depth
Developed Condition

2020/04/07 B

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Gov Macquarie Dr

Refer Inset

HAIGH PARK

LAKE
MOORE

Newbridge Rd

Heathcote Rd

GEORGES RIVER

Western Motorway

Cambridge Ave

Inset

HAIGH PARK

LAKE
MOORE

Bridges Rd

Newbridge Rd

Heathcote Rd

GEORGES RIVER

Proposed Levee

LEGEND

FLOOD DIFFERENCE (m)

- 0.5 +
- -0.10 to 0.5
- -0.08 to 0.10
- -0.06 to 0.08
- -0.04 to 0.06
- -0.02 to 0.04
- -0.02 to 0.02
- 0.02 to 0.04
- 0.04 to 0.06
- 0.06 to 0.08
- 0.08 to 0.10
- 0.1 to 0.5
- 0.5 +
- Areas that were flood affected and are now flood free in modelled event
- Areas that were flood free and are now flood affected in modelled event
- Study Area

N

0 360
metres
Scale 1:9,000 @ A3

Projection: GDA 1994 MGA Zone 56

Figure - 6.9
Moore Point
Flood Impact Assessment

1% AEP Flood Level Difference
Developed Minus Existing

2020/04/07 B

Filename: Figure 6.9 - 1%AEP_WLDifference_DES03_MINUS_EX02_001.wor