FLOOD ASSESSMENT REPORT

Wee Hur Regent, 90 - 102 Regent Street, Redfern, NSW 2016

REPORT FOR NSW Department of Planning, Industry and Environment (DPIE)

JHA

CONSULTING ENGINEERS

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Key Contact	Jimmy Soo

Prepared By

Company	JHA
Address	Level 23, 101 Miller Street, North Sydney NSW 2060
Phone	61-2-9437 1000
Email	Jimmy.Soo@jhaengineers.com.au
Website	www.jhaservices.com
Author	Jimmy Soo
Checked	
Authorised	

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1 EXECUTIVE SUMMARY

1.1 INTRODUCTION

JHA has been engaged by The Trust Company (Australia) Limited ATF WH Regent Trust to provide stormwater and drainage services, flood analysis, and including preparation of this report. This flood assessment report with attached stormwater concept plans forms part of the submission for the Development Application.

The proposed development is to construct a new student accommodation known as Wee Hur Regent, located at 90 - 102 Regent Street, Redfern, Redfern, NSW 2016. The site is identified as Lot SP57425, DP184335, and DP3954, with a total area of 1287 m2 (refer Survey Plan in Appendix B01 to B04). The existing site consists of a mixture of 2 to 4 storey brick residential buildings. Generally, the entire site is paved and impermeable, with small landscaping areas.

The adjacent site at the south of this development is a BP service station with its associated café and mini grocery shop. The adjacent site at the west is the former City of Sydney Council deport. The former Council depot is being redeveloped to accommodate affordable rental housing. Across Margaret Street to the south is a five-storey residential flat building fronting Gibbons Street and a church building fronting Regent Street. Further to the west of the site across Gibbons Street is Gibbons Street Reserve. The adjacent site at the north is the future 18 storey student housing under construction. The adjacent site at the east across the Regent St is a mixture of apartment buildings, shops, and car-repair workshops.

This report will be assessed by the NSW Department of Planning, Industry and Environment (DPIE). The proposed development is classified as State Significant Development as it has a project value of more than $10million. This stormwater report addresses the site stormwater and flood issues with reference to the following documents.

1) Secretary's Environmental Assessment Requirements (SEARs Application Number SSD 10382 dated 27 November 2019).
2) City of Sydney Council – Interim Floodplain Management Policy and Sydney Local Environmental Plan 2012 item 7.15 Flood planning.
3) NSW Floodplain Development Manual (DIPNR, 2005).
4) Australia Rainfall and Runoff 2019, (ARR 2019).

This report shall address item 14 and others relevant to flood issues of the SEARS "drainage and flooding issues" associated with the site. This item includes:

a) The submission of a stormwater management plan which considers the impact of the development on the existing stormwater infrastructure both in terms of stormwater quantity and quality impacts. The stormwater management plan is provided in the form of pdf drawings complete with explanatory notes, to demonstrate the concept of the stormwater design and treatments to reduce the environmental impacts. Digital files of MUSIC analysis and DRAINS calculation will be submitted together with the drawings. The proposed site has space constraint and the Architectural layout may change quite often to overcome this constraint. Likewise, the propose stormwater quantity and quality treatment may be frequently revised. Considering that the flood study is independent of the space constraint; this report would exclude the discussion of stormwater design that will be incorporated in a drawing set of the stormwater management plan.

b) An assessment of any flood risk in accordance with the guideline contained in the NSW Floodplain Development Manual (DIPNR, 2005) including potential effects of climate change and an increase in rainfall intensity. Climate change and increase in rainfall were investigated by Cardno in their "Alexandra Canal Catchment Flood Study". The findings and results will be discussed in Chapter 3.

c) The site's frontage to William Lane is subject to flooding and as such any proposed access to the basement area needs to be above the probable maximum flood level. The ground floor retail space needs to be at or above the 1% annual exceedance probability flood level. A new flood analysis and study is carried out using the HEC-RAS 2D modelling software. A full account of the design, procedure and results; will be documented in Chapter 4 and 5.

d) The general requirements of the SEARs require the key issues (including stormwater) to be assessed having regard to adequate baseline data, consideration of the cumulative impacts due to other developments (completed/underway/proposed) and clear identification of the measures to avoid, minimize and off-set predicted impacts. Floodwater interacts with the proposed buildings, infrastructure and the surrounding terrain. The interaction and mitigation measures are discussed in Chapter 5.

Generally, this report intention is to determine that this development:

(a) is compatible with the flood hazard of the land, and

(b) is not likely to significantly adversely affect flood behaviour resulting in detrimental increases in the potential flood affectation of other development or properties, and

(c) incorporates appropriate measures to manage risk to life from flood, and

(d) is not likely to significantly adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses, and

(e) is not likely to result in unsustainable social and economic costs to the community as a consequence of flooding.

This report is prepared by experienced Chartered Professional Civil Engineer from JHA registered with NER.

1.2 LIMITATIONS OF THIS REPORT

This report only serves the purpose of what it was intended to address the stormwater, flood and drainage issues based on the information that is available at the time of preparing this report. This report is not intended for use as a scope of works for tender or other unrelated purposes. Data extracted from this report shall not be used for any construction work. This report may contain outdated drawings. Please refer to the relevant parties for their latest drawings.

2 THE ALEXANDRA CANAL CATCHMENT AND FLOOD CONDITIONS

The proposed development site is located within the Alexandra Canal catchment for which the City of Sydney Council has conducted several flood studies as follows:

1) Alexandra Canal Catchment Flood Study – Report Final, Project W4785 prepared by Cardno
2) Alexandra Canal Floodplain Risk Management Study and Plan, Project W4948 prepared by Cardno
3) 11 Gibbons Street, Redfern Site Flood Assessment, prepared by WMA water Pty Ltd. This property is situated just north of this proposed development.

A flood study required us to examine the entire catchment which is usually much larger than the proposed development site area; with a focus on the site stormwater and drainage features. The Alexandra Canal catchment area is approximately 1,141 ha and includes the suburbs of Alexandria, Rosebery, Erskineville, Beaconsfield, Zetland, Waterloo, Redfern, Newtown, Eveleigh, Surry Hills and Moore Park. The majority of the catchment is fully developed (consist of housing, commercial and industrial areas) with some large open spaces. The trunk drainage system is mostly owned by Sydney Water Corporation, while the smaller feeding drainage systems owned by local councils. In this regard, Sydney Water Corporation has informed that the proposed Regent St development requires On-Site Detention (OSD) volume of 20 m3 and Permissible Site Discharge (PSD) of 47 l/s.

The extent of the flood study with the existing pits and pipe system is shown in Appendix A01 (an extract of Figure 4.3 from Alexandra Canal Flood Study). Wee Hur Regent site is located near the upstream end of the Alexandra Catchment with Council's existing street underground drainage network of pits and pipes along Regent Street, Marian Street and William Lane. The site elevation is between RL 20.00m to RL 30.00m as shown in Appendix A02.

During the major storm event 100 years ARI, the flood study results shown in Appendix A03 indicate the site is not inundated. There is a flood at the southern part of William lane. Floodwater is prevented to enter the downstream properties due to the elevated courtyard of downstream property which is about 700mm higher than the street level of William Lane at approximately RL24.11 (Refer to Appendix B02 Survey drawing). Retaining wall was built at the south end of William Lane causing stormwater to be ponded and cause local flood (Refer to photos at Appendix C05). There are two existing kerb lintel pits situated on both sides of William lane near the site's southwest corner with an underground pipe of 225mm diameter. The survey shows these pits diverts part of the trapped floodwater to Regent Street via underground pipe of 300mm diameter running eastward underneath the BP's Cafe building. The peak flood depth of this location shown in Appendix A04 is in the region of 0.5m-0.69m (cyan colour). Due to the low velocity, this location is designated as Low Hazard as shown in Appendix A05. There is no sign of flood shown along the along Regent St, Marian St and William Lane that form the boundaries of this development.

During the extreme storm event, i.e., the probable maximum flood (PMF), the flood study results in Appendix A06 indicate flood occur along William Lane and Regent St. The peak flood depth generally is in the region of 0.1m-0.3m (orange colour) as shown in Appendix A07. William Lane and part of the BP Station are inundated. Part of the retaining wall at the dead-end of William Lane has collapsed (refer to photo at Appendix C05) and floodwater could flow from William Lane into the compound of the BP Station (refer to photo at Appendix C06). The floodwater depth of the existing pit could reach 0.7-0.99m. However, due to the relatively low velocity of flow, the entire site is designated as Low Hazard as shown in Appendix A08.

The NSW Floodplain Development Manual defines flood-prone land to be one of the following 3 hydraulic categories:

a) Floodway – Areas that convey a significant portion of the flow. These are areas that, even if partially blocked, would cause a significant increase in flood levels or a significant redistribution of flood flows, which may adversely affect other areas.

b) Flood Storage – Areas that are important in the temporary storage of the floodwater during the passage of the flood. If the area is substantially removed by levees or fill it will result in elevated water levels and/or elevated discharges. Flood storage areas, if completely blocked would cause peak flood levels to increase by 0.1m and/or would cause the peak discharge to increase by more than 10 %.

c) **Flood Fringe** – Remaining area of flood-prone land after Floodway and Flood Storage areas have been defined. Blockage or filling of this area will not have any significant effect on the flood pattern or flood levels.

The site is not flooded in the 100 years ARI event as shown in Appendix A09. During the PMF event, due to the relatively higher flow velocity of floodwater on the street of Regent St, the flood here is designated as floodway (blue colour as shown in Appendix A10). At the BP station compound; certain part of this area is designated as flood storage (green colour).

3 CLIMATE CHANGE AND INCREASED RAINFALL INTENSITIES

The NSW Office of Environment and Heritage (formerly Department of Environment, Climate Change and Water (DECCW)) guideline, Practical Consideration of Climate Change (2007), provides advice for consideration of climate change in flood investigations. The guideline recommends sensitivity analysis is conducted for:

- Sea level rise – for low, medium, and high level impacts up to 0.9m
- Rainfall intensities – for 10%, 20%, and 30% increase in peak rainfall and storm volume

In the Alexandra report, models were run for 100 years ARI 90 minutes storm for the increased rainfall intensities of 10%, 20% and 30% with an elevated tailwater level of 2.9m AHD to Alexandra Canal. Appendix A11, A12 and A13 indicate the difference in peak water level compared to the base 100 years ARI 90 minutes event of rainfall increment of 10%, 20% and 30% respectively. For the 10% increment, Appendix A11 indicates no rise in flood level. For the 20% (A12) and 30% (A13) increment indicates (pink region) an increase of 10mm to 20mm flood level.

With reference to Cardno's flood study on sea-level rise with the following quote: "The climate change assessment in the Cooks River Flood Study (2009) modelled peak water levels for the case of 20% increase to rainfall intensity and a mid-range sea-level rise of 0.55m for the 100-year ARI. A peak tailwater level of 2.9m AHD was estimated from these climate change scenario results for application to the Alexandra Canal catchment model. Given that the model is generally only sensitive to downstream boundary levels in the immediate vicinity of Alexandra Canal, a single downstream boundary scenario is considered reasonable". In view that this development is situated at the upstream end of the Alexandra Canal catchment; the rise of sea level due to climate change will not impact on this property.

With reference to Cardno's flood study on increase in rainfall intensities with the following quote: "Climate change, including an impact of sea-level rise and rainfall intensity increases, has been assessed and the likely increase in peak water levels observed. The analysis demonstrates that the model is generally more sensitive to pit and culvert blockages than to climate change". In this report, the flood study carried out using Hec-Ras 2D modelling is based on the full blockages of all the pits and pipes. The results generated will be more conservative than to implement the effect of increasing rainfall intensities due to climate change.

ARR 2019 proposed the use of a six-step process Decision Tree for incorporating Climate Change in flood design as shown in Figure 1.6.2. of the manual. In Step 2 "Set the flood design standard" with the following quote: "If the design standard is the Probable Maximum Flood (PMF), use an up-to-date estimate of the Probable Maximum Precipitation (PMP) to determine the PMF. This approach has an appropriate degree of conservatism as PMP estimates are updated by the Bureau of Meteorology (BOM) from time to time. This will ensure that any future climate change signal is captured and thus the PMP should not be further adjusted to take into account potential climate change implications".

Our flood study is based on the ARR2019 standard with rainfall data downloaded from BOM for the rare rainfall event of PMP (1 in 2000 years). These values have taken into account potential climate change implications as mentioned above. In these regards, climate change and increase of rainfall intensities are incorporated in this flood study.

4 THE PRE-DEVELOPMENT SITE AND FLOOD CONDITIONS

The existing site terrain generally slopes from northeast to southeast, refer to Appendix B02 and photos in Appendix C. The existing site consists of a mixture of two to four-storey brick buildings with the front-facing Regent Street. The northern building is a two-storey residence with a car park at the rear occupied about half of the lot areas (Refer to Appendix C4). This house is still in good condition. At the south, there are 3 two-storey shop-lots which are vacant. The southernmost building is a 4-storey apartment with a basement.

The high end of the site generally at RL27.0 (Refer to Appendix B02) at the intersection of Regent St and Marian St; sloping to the low end of the site at RL24.40 at the southwest corner of the site facing William Lane. Floodwater flowing along the street gutter of Regent St will be bifurcated into two flood streams flowing along Marian St and Regent St (Refer to Appendix C02).

Results derived from Alexandra Canal Flood study and Flood Assessment Report of 11 Gibbons Street (neighbouring property situated at the west of this development) by WMA indicate that the existing building is not flooded during the major storm event of 1% AEP. Due to the existing retaining wall, the trapped low point of William lane could pond to a depth of about 0.9m in the 1% AEP event. The dead-end lane is drained via a 300mm underground pipe that conveys flows east to join the Regent Street stormwater drainage network. When runoff exceeds the capacity of this pipe, stormwater ponds in William Lane until overflow via the compound of the BP Station toward Margaret Street (Refer Appendix C06). Given the depth of ponding, William Lane is considered as subject to "mainstream flooding". The 1% AEP Peak level (mAHD) of this low point of William Lane is estimated at RL24.82 from these reports.

However, the flood level data derived from the above-mentioned reports are insufficient to provide the determination of the design flood level for this development. As such, at a smaller scale flood analysis, focus on the site pre and post development condition are carried out with similar modelling methodology and design procedure adopted by previous flood study reports. Hec-Ras Version 5.07 (Hydrologic Engineering Centre–River Analysis System) has the 2D flood analysis capabilities and was used for flood analysis for this development. However, the previous flood study of the Alexandra Canal utilized the SOBEK and TUFLOW software. Similar to the previous flood study methodology, aerial laser scanning (ALS) ground levels surveyed in 2007 and 2008 were downloaded from NSW Government websites for this development area and encompassed all the upstream catchment areas. Generally, the accuracy of the ALS data is +/- 0.15m to one standard deviation on hard surfaces. We have also merged the local survey data into the terrain, particularly the land survey data of existing "kerb & gutter" and footpath levels. We visit and inspect the site; took several photos and found that the downloaded data does correlate to the terrain on the ground.

Direct rainfall method (also known as rain-on-grid) was used in this flood study; similar to the previous flood studies. The critical duration of the major storm (1 % AEP) and PMF were taken from the previous reports as follows:

Average Recurrence Interval	Critical Durations
1 year to 100 year	60 to 120 minutes
PMF	15 to 45 minutes

We use DRAINS software (by Watercom) to generate the rainfall input based on ARR2019 procedure. The rainfall data is downloaded from the Bureau of Meteorology based on the location of the development and the temporal pattern is downloaded from ARR Data Hub website. ARR2019 recommended the use of 10 ensembles of storm bursts (storm pattern named Storm1 to Storm10); for each duration of a storm event. The rainfall data from BOM include frequent storm event such as monthly storm (12 EY), 1 in 100 years ARI (1% AEP) to the rare event such as 1 in 2000 AEP which we adopt as PMP (probable maximum precipitation). Appendix D01 shows the IFD rainfall data downloaded from BOM.

We carried out a simple stormwater analysis in Drains based on the single overland catchment of 3.47 ha. The results show that the overland flow is 2.14m^3/s and 3.45 m^3/s for 1% AEP and the PMP (1 in 2000 AEP) respectively. These flows data are never used in the flood analysis as they only represent the concentrated flow from a single catchment. In flood analysis, a more accurate method such as direct rainfall; shall be utilized to take account of the splitting of flow into multiple flood streams as stormwater flow downstream on the complex urban terrain. The results of peak flow table from the drains analysis shows the critical storm burst for each duration of the storm event. For example, the critical storm burst for the 1% AEP 15min duration storm event is the ensemble "Storm2" and the PMF 15min duration storm event is the ensemble "Storm2" as well (Refer to Appendix D02 and D03).

With the critical storm burst ensemble identified, we open the rainfall data panel (AR & R 2019 Rainfall Ensembles panel) and obtain the hyetograph of the critical rainfall data. Drains hyetograph are provided in 5 min interval. However, the rainfall intensities values are in mm/hr which we shall convert to mm/5min interval. Appendix D04 and D05 show the Excel tables of converted rainfall intensities for flood study for 1% AEP and PMP respectively to be used in Hec Ras Flood Analysis. The hyetograph rainfall data derived from DRAINS shall be paste into the "precipitation" panel of the Unsteady Flow Data panel for direct rainfall analysis in Hec Ras. For example, Appendix E01 shows a snapshot of the precipitation data for 1% AEP 120 min duration storm event.

In Hec Ras, a 2D flow area is drawn, consist of 20,520 cells cover the site area from Margaret St (lowest boundary) to Lawson St (highest boundary) as shown in Appendix E02. HEC RAS takes a very different approach from other software in 2D flow area modelling. The cells can have 3, 4, and 5 up to 8 sides. Each cell is not a simple plane, but a detailed elevation and volume/area relationship that represents the details of the underlying terrain. Each cell face is a detailed cross-section, which gets processed into detailed elevation versus area, wetted perimeter and roughness. This approached allows the modeller to use larger cell size and still accurately represent the underlying terrain. As such, Hec Ras will determine where the boundary and the size of the catchment hydrologically during the direct rainfall analysis, without manual area delineation by the user, which could be inaccurate.

Appendix E03 shows the contours of the ALS terrain at intervals of 0.2m; in which contours of RL27.00 the North-East corner of the site matching the ground level survey at the footpath at RL27.00 as shown in Appendix B02. Contours of RL24.40 at the south-west corner of the site also matching the survey data of RL24.40 with negligible differences in location.

We use the "precipitation" or "rain on grid" method to analyse the flood of pre-development scenario. Using the particle tracing capability of Hec-Ras we can visualize the flow path of floodwater as shown in Appendix E04. Long parallel white lines indicate the flow is fast; while short white lines and white dots may indicate slower flow and local ponding respectively.

The overland stormwater that flows along Regent St from the North, bifurcate or split at the intersection of Marian St and Regent St; due to the shape of the existing kerb return. Most of the stormwater flow along Marian St and later flow into William Lane. The remainder stormwater continues to flow along Regent St toward BP station. At the north of William Lane, stormwater flows south and part of the stormwater cross Marian St and continue towards the existing retaining wall at the south end of William Lane. Stormwater will be drained by existing underground drainage pipe eastward to Regent Street. However, during the Major storm (1% AEP) and Rare storm (1 in 2000 AEP) event; flood will occur at this location and may inundate the garage and courtyard of existing buildings as shown in Appendix E04 (PMF 15 min duration).

Appendix F01, F02, F03, F04 and F05 show the results of maximum flood depth for the 1% AEP storm for the critical durations of 15min, 30 min, 60min, 90min and 120min respectively. Appendix F06 and F07 show that the highest flood depth is found to be about 0.867m at the William Lane lowest sag point during the 1% AEP 30min duration storm. This is only about 67mm higher than the results of 0.8m depth as shown in the report of "11 Gibbons Street, Redfern Site Flood Assessment, prepared by WMA water Pty Ltd" using Tuflow software.

The small increase in flood levels could be due to the following assumptions or methodology adopted that may differ from the previous flood study:

i) Existing pits and pipe are assumed to be fully blocked

ii) No allowance for soil infiltration losses as the upstream catchment is fully developed.

iii) The Rainfall data of ARR2019 from BOM take account of climate change and increased in intensities.

Appendix F08, F09, and F10 show the results of maximum flood depth for the 1 in 2000 AEP storm (PMP) for the critical durations of 15min, 30 min, and 45min respectively. Appendix F11 and F12 show that the highest flood depth is found to be about 0.883m at the William Lane lowest sag point during the PMF 15min duration storm. This is within the range of 0.7-0.99m depth result as shown in the report of "Alexandra Canal Catchment Flood Study – Report Final, Project W4785 prepared by Cardno" using Sobek software.

In this regard, we are confident that the Hec Ras results are conservative and generally match the results from previous Flood Analysis that were accepted and approved by the City of Sydney Council.

The critical duration of 1% AEP and 1 in 2000 AEP storm events for the predevelopment scenario are 30min and 15min respectively. Appendix F13 shows the maximum flood velocity at about 0.75m/s for the 1% AEP at William Lane. Appendix F14 shows the maximum flood velocity at about 0.883 m/s for the 1 in 2000 AEP at William Lane. Appendix F15 and F16 show the flood surface levels at the sag point of William Lane at RL24.883 and RL24.898 for the 1% AEP and 1 in 2000 AEP storm events respectively.

5 THE POST-DEVELOPMENT SITE AND FLOOD CONDITIONS

5.1 FLOOD ANALYSIS RESULTS

The proposed development is a tower of 18 storey high buildings with the roof, reaching RL84.80. Appendix G01 and G02 shows the Architectural layout of the basement and ground floor. The build-up area occupied almost the entire footprint of the lot with an offset of 0.8m for a footpath along William Lane.

The post-development terrain of the site is modelled using 12D Model software and imported into HecRAS. We modelled the post-development building ground floor levels in 12D as completely flat in accordance with the Architectural design, instead of a sloping platform as it was generally represented in the pre-development stage. We also combined the footpath model derived from the land survey data using 12D.

Hec-RAS GIS tools (Ras Mapper) is capable to merge the 12D model with the ALS catchment terrain. Appendix H01 shows the contours of the post-development terrain at 100mm interval.

We had carried out flood study for another Wee Hur property (SP60485) downstream, south of the retaining wall at the end of William Lane (Refer Appendix B01). We proposed a flood drain or swale to allow trapped floodwater by the existing retaining wall to escape into the BP Station compound. This is one of the several flood remedial measures proposed for that property. The existing retaining wall is considered removed in this post-development flood analysis. Appendix H02 shows a profile of the William Lane along with Wee Hur Gibbons property. The existing retaining wall and the courtyard high elevation is lower to create a public domain driveway in the post-development scenario.

We use the “precipitation” or “rain on grid” method to analyse the flood for 1% AEP with the durations of 15min, 30min, 60min, 90min and 120 min. The results are as shown in Appendix H03, H04, H05, H06 and H07. Appendix H08 and H09 show that the highest flood depth is 0.351m at William Lane sag point during the 1 % AEP 15min duration storm. There is a depth reduction of 0.516m from the predevelopment scenario. This reduction is due to the flood mitigation flood drain proposed in Wee Hur Gibbons St development project as mentioned above.

Appendix H10, H11, and H12 show the results of maximum flood depth for the 1 in 2000 AEP storm (PMP) for the critical durations of 15min, 30 min, and 45min respectively. Appendix H13 and H14 show that the highest flood depth is found to be about 0.390m at the William Lane sag point during the PMF 15min duration storm. There is a depth reduction of 0.439m from the predevelopment scenario. This reduction is also due to the flood mitigation flood drain as mentioned above.

The critical duration of 1% AEP and 1 in 2000 AEP storm events for the post-development scenario are both 15min duration. Appendix H15 shows the maximum flood velocity at about 0.817m/s for the 1% AEP at William Lane. Appendix H16 shows the maximum flood velocity at about 0.921 m/s for the 1 in 2000 AEP at William Lane. Appendix H17 and H18 show the flood surface levels at the sag point of William Lane at RL24.387 and RL24.429 for the 1% AEP and 1 in 2000 AEP storm events respectively.

There is a disadvantage using the “rain on grid” method for the post-development scenario, Due to the Architectural floors are modelled flat, all the results as mentioned above indicate there is a thin layer floodwater at the interior building. If we visualize the flood flow using the particle tracing, we may able to distinguish the overland flood and the local ponding due to flat ground. However, this could be difficult to illustrate in a report.

In order to differentiate that the interior floodwater is not coming from overland flow, we carried out 2nd run analysis without using the “rain on grid” method. In this first-run analysis, we identified that there are two overland flood streamflow from the North, along Regent St and William Lane at the north end. Hence, we draw boundary condition “inflow line1” along Regent St and boundary condition “inflow line2” along William Lane (Refer to Appendix J01)

From the above analysis, we obtained the flow hydrographs for inflow line 1 for the 15 min duration of 1% and 1 in 2000 as shown in Appendix J02 in graph format. Appendix J03 shows these hydrographs values in a table format. The results of the hydrographs as shown in Appendix J04 indicate that the 1% AEP 15min duration is the critical storm event. Therefore, we will not present the results of another duration of storm event that is not critical.

The flow hydrographs for inflow line 2 for the 15 min duration of 1% and 1 in 2000 as shown in Appendix J05 in graph format. Appendix J06 shows these hydrographs values in a table format.

We use the flow hydrographs of inflow line 1 and 2 as the stormwater source instead of the "precipitation" during the 2nd run of the flood analysis. Appendix J07 shows the flood map of flood-depth for the 1% AEP 15min duration and Appendix J08 shows the flood map of flood-depth for the PMF 15min duration. The results show that there is no flood or inundation to the proposed Architectural floor levels. There is no ponding of water on the interior floor areas. The floodwater along William Lane inundate the footpath at several locations but did not enter the footprint of the buildings. However, the values of flood depths at the William Lane sag point, are shown lower than the results using the "rain on grid" method. This is due to the fact that the catchment of post-development is not included in 2nd run analysis using the overland hydrographs method. As such, the second run is used as a check to differentiate the local ponding from the overland flow.

Therefore, the following profile plots of 1% AEP 15min duration shall include both the 1st and 2nd analysis run. The 1st run indicates the height of the floodwater while the 2nd run indicates the extent of the flood inundation. We shall ignore the water-line of the first run that is shown over the interior floor due to local ponding generated by "rain on grid" method. Appendix J09, J10, J11, J12 and J13 show the profile of the floodwater surface for sections A, B, C, D and E respectively. Appendix J14, J15 and J16 show the profile of the floodwater surface along the kerb lines of Regent St, Marian St and William Lane respectively.

Similarly, the following profile plots of PMF 15min duration shall include both the 1st and 2nd analysis run. Appendix J17, J18, J19, J20 and J21 show the profile of the floodwater surface for sections A, B, C, D and E respectively. Appendix J22, J23 and J24 show the profile of the floodwater surface along the kerb lines of Regent St, Marian St and William Lane respectively.

5.2 FLOOD PLANNING LEVELS

City of Sydney Council has a responsibility to manage flood-affected properties to ensure that:

- Any new development will not experience undue flood risk; and
- Any existing development (neighbourhood) will not be adversely flood-affected through increased damage or hazard as a result of the proposed new development.

The flood analysis results of pre-development and post-development, both indicate that there is no floodwater enter the buildings during the 1% AEP and PMF storm events. This new development will not experience undue flood risk. There is no increase in flood storage. Therefore, this new development will not adversely affect downstream neighbourhood properties.

Nevertheless, the development shall comply with the floor level requirements as specified in the "City of Sydney Interim Floodplain Management Policy" as shown in Appendix K01 and K02 (chapter 5-Flood Planning Levels). A flood planning level refers to the permissible minimum building floor levels. Below-ground basement/parking shall refer to the minimum level at each access point such as staircase, elevator or vehicle entrance.

We proposed the Flood planning levels (FPL) as shown below (Refer Appendix H03). The proposed floor planning levels are in line with the City of Sydney council recommendation of 500mm freeboard of the habitable areas such as living room and bedrooms, 300mm freeboard for garage and above floodwater for non-habitable areas. The flood levels are measured from the upstream end of the room projected perpendicular to the building wall to the external flooded areas. In this development, living rooms and bedrooms are located at 1st Floor and they are more than 2.5m above any possible flood events. We consider loading dock as non-habitable areas for unloading, rather than for parking such as a garage.

PROPOSED MINIMUM FLOOD PLANNING LEVELS TO COUNCIL REQUIREMENTS

Item	GroundFloor Rooms / Entry Point	Proposed FPL	1% AEP Flood Surface Levels (m)	Freeboard (mm)	Comment
1	Common Main Hall	27.00	26.74	0.26	Meet requirement above flood level
2	Common Second Hall	26.13	26.00	0.13	Meet requirement above flood level
3	Retail	25.95	25.80	0.15	Meet commercial requirement
4	Ground Floor Kitchen	27.00	26.05	0.95	Meet requirement above flood level
5	Laundry	27.00	26.28	0.72	Meet requirement above flood level
6	Main Switch Room, Substation	24.80	24.45	0.35	Meet requirement above flood level
7	Truck turntable/ loading dock	24.90	24.85	0.05	Meet requirement above flood level
8	Waste Area	24.90	24.85	0.05	Meet requirement above flood level
9	Comms, Gas and Water Meter room	24.90	24.50	0.40	Meet requirement above flood level
10	Regent St stair enter to basement	25.50	25.30	0.20	Meet requirement above flood level

6 DISCUSSION AND CONCLUSION

The flood studies done by other consultants such as Cardno and WMA provide preliminary information on the flood situation of the pre-development site. The site is generally is not affected by flood for the 1 % AEP storm event and PMF. However, further downstream at the southern end of William lane, at the existing retaining wall, the flood depth of 0.8m was reported.

We have analysed the flood situation for both pre-development and post-development using Hec Ras. Terrain data or "DEM" (digital elevation model) was downloaded from NSW government websites. We found that the DEM model matches the survey data ground surface levels. The Hec Ras flood analysis results are compared with the previous flood study and found to be quite similar and slightly conservative.

In this flood study, we adopt rainfall data using the ARR2019 procedure with incorporate of climate change and increased in rainfall intensities. The proposed flood drain for the Wee Hur Gibbons St development will allow trapped floodwater to escape. This flood mitigation measure will reduce the flood situation at William lane by about 500mm in depth.

The proposed flood planning is tabulated in the previous chapter are compliance with the Council requirements. As a conclusion, this development is located in a flood safe area. The proposed flood planning levels are satisfactory.

7 APPENDICES