ECLIPSE | CONSULTING ENGINEERS

Revised
Flood Impact Report

Proposed Motel Development

At

Armidale Ex-Services Memorial Club, Dumaresq Street, Armidale

For

Armidale Ex-Services Memorial Club

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1. INTRODUCTION

1.1 Background

ECLIPSE Consulting Engineers Pty Ltd was commissioned by Armidale Ex-Services Memorial Club to complete a Flood Impact Report for the proposed alterations and additions to the existing club located on Dumaresq Street, Armidale which includes the development of a new 5-star motel complex and associated car parking.

A site inspection of the proposed development was carried out by Stephen Healey from ECLIPSE Consulting Engineers on Tuesday 24th November, 2009, to review the existing site conditions. This included a meeting with Council representatives David Stellar & Robbie Blair.

A subsequent meeting with Council Representatives was held on Friday 25 June, 2010. The following is a summary of the main issues raised during that meeting that are to addressed by this revised report:

- Review of the recommendations in the Floodplain Development Manual
- Details of the flood study modelling carried out
- More detailed flood emergency response details
- A more detailed review of the flood hazard category associated with occupant use and public safety

The location of the development site in relation to Dumaresq Creek is shown in Figure 1, below.

Figure 1 – Location of Subject Site

This report has been compiled to review:

- the impact of the proposed development on the flooding of Dumaresq Creek
- the safe operation & emergency response if required of the proposed development in a major flood event

1.2 Existing Site

The site falls within the boundaries of Armidale Dumaresq Council and is therefore subject to Council's Development Application approvals processes, DCP's and LEP's. The site is located within moderately flat terrain. The overall ground surface slopes down to the north-west to south east at approximately 0.3 % towards the Dumaresq Creek. The layout of the existing site is shown in Figure 2, below.

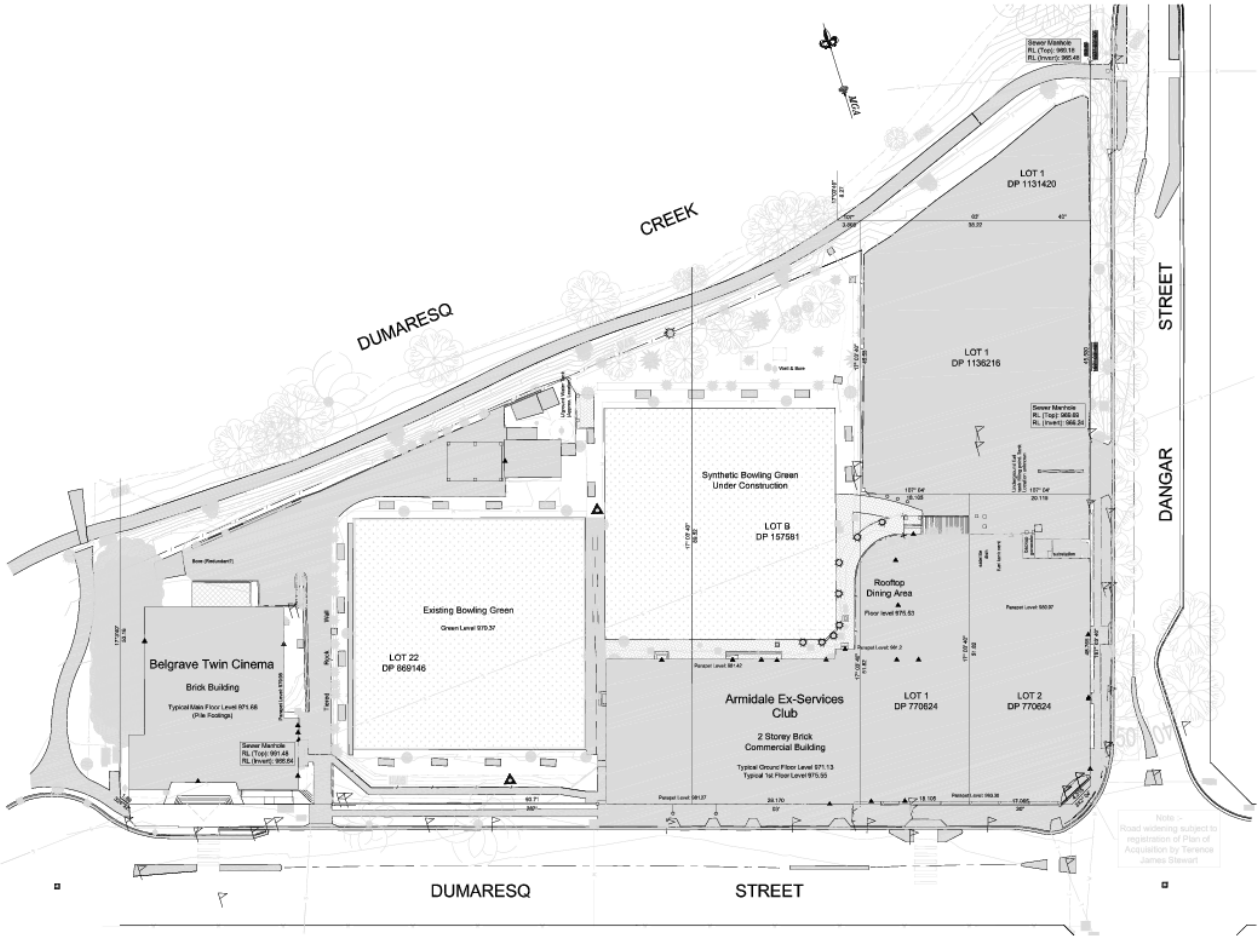


Figure 2 – Existing Site Layout Plan

1.3 The Proposed Development

The proposed development comprises the demolition of an existing out building and bowling green on the site with associated retaining walls, garden beds and minor structures. The building works include the construction of a new motel, double level car parking and new access driveway. At the completion of all stages of the development the existing cinema & club buildings will be linked via the motel lobby and reception area.

The development will be constructed in three stages, the building works are as summarised below:

- Stage 1: Construction of a double storey parking structure, new club entry, managers unit, twenty-three motel units and three executive units, and new access driveway, paths and ramps.

- Stage 2: Modifications to the existing bike track, new driveway connecting to the existing club car park, extension of the stage 1 upper level car park, construction of a new bowlers amenities and meeting facility,

- Stage 3: Additional twenty-two motel units/suites, porte cochere and new awnings.

The proposed Stage 2 layout of the development is shown in Figure 3, below. A copy of the Development Application architectural drawings may be found in Appendix A.

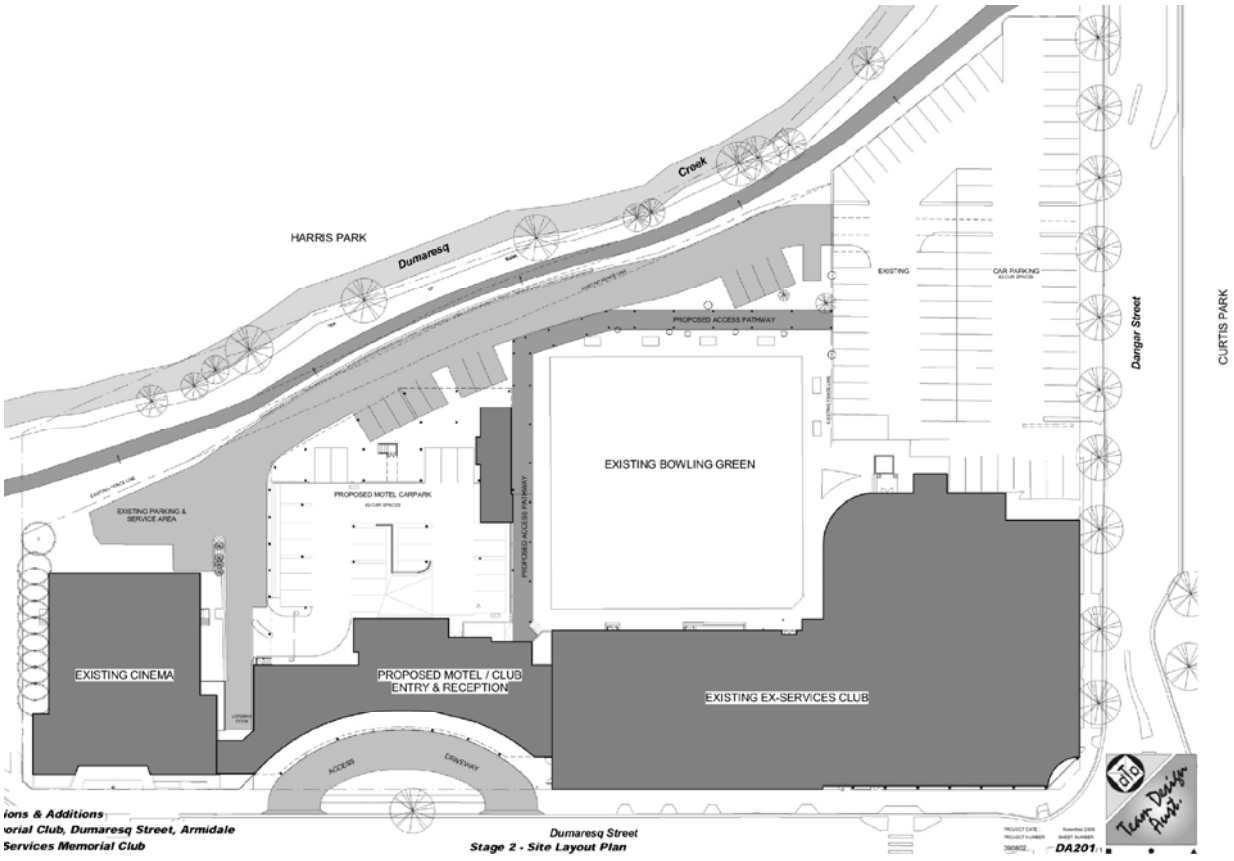


Figure 3 – Proposed Development Stage 2

1.4 Flood Risk Assessment

This report quantifies the flood water levels and identifies the flood risks and management procedures necessary for the proposed new development. This report provides:

- A review of flood hazards for the site & proposes suitable construction methods to accommodate them.
- A review of the impact of flooding on the proposed development and the surrounding properties & any modifications to the design that might be required to minimise any adverse impacts.
- Guidelines to alert the building owners and occupiers to the hazards of flooding at this site.

The objective of the hydrological review was to ensure that the development does not adversely affect neighbouring properties and to provide adequate free board against the peak storm event. In order to achieve this, the following scope of works was carried out:

- Review of existing flood studies, management reports, etc prepared for the Armidale area.
- Liaison with Local Council officers regarding the proposed development and implementation of suitable development controls to ensure adequate performance of the proposed development during flood events.
- A review of existing topography maps, flood inundation maps, flood hazard maps, etc.
- Visual observations of surface features of the existing site.
- Engineering assessment and reporting of the proposed development and its impact on the existing residences.

Flood risk management will be achieved by imposing the following guidelines:

- Structural design of the proposed development to resist additional loadings due to flooding, including the effects of impact loading from floating debris, etc.
- Use of flood proof materials in the building's construction in accordance with Council's policy.
- Ensure motel guests & employees remain safe in a flood event and if required, have a safe means of escape if an evacuation is deemed necessary.

1.5 Referenced Documentation

The following documents have been reviewed during the preparation of this report:

- Armidale Flood Study 2004
  Prepared by Armidale Dumaresq Council
  Version 2, dated 24 April 2006

- Armidale Dumaresq Council DCP 2007
  Chapter B7 – Stormwater Drainage Code

- Armidale Dumaresq Council
  Interim Flood Plan (POL038)
  23 October 2000

- Department of Infrastructure, Planning and Natural Resources
  Floodplain Development Manual – The Management of Flood Liable Land
  April 2005

2. EXISTING SITE

2.1 Background

The subject site is on the northern side of Dumaresq Street and southern side of Dumaresq Creek. The area of the site to be re-developed is currently used as a lawn bowling green and has a small out building erected on it. Pedestrian access is from Dumaresq Street along the western frontage of the site. Vehicular access in Stage 2 will be from Dangar Street through the existing car park.

A site survey was undertaken in November 2009 by Hawkins Hook & Co., a copy of the survey plan may be found in Appendix B.

2.2 Catchment Details & Modelling Approach.

The review of the flood impact for this site and the assessment of flows have been based on the relevant national design guidelines, Australian Standard Codes of Practice, the standards of Armidale Dumaresq Council and accepted engineering practice. Overall site runoff and stormwater management will be designed in accordance with the Institute of Engineers, Australian publication “Australian Rainfall and Runoff” (1987 Edition), Volumes 1 and 2 (AR&R).

Armidale Dumaresq Council have provided their current HEC-RAS computer modelling for the Dumaresq Creek catchment, the model was developed from a number of sources including their GIS arial survey data. A review of the model with the relevant cross sections on our site has revealed the current model is very accurate.

The peak flow rates of the catchment were used based on rainfall intensity-frequency-duration relationships for the area, corresponding antecedent moisture condition, varying times of concentrations and overland flow times for individual nodes. The results of the modelling have been compared against know flooding events to confirm their validity. The flow-rates have been adopted for this Flood Impact Report with no further analysis or design review undertaken ECLIPSE Consulting Engineers.

2.3 Hydrology Review

From the Armidale Flood Study 2004, the adopted critical duration storm for Dumaresq Creek was adopted to be 9 hours. The corresponding critical peak flow at Stephens Bridge (Marsh Street) was calculated to be:

- 1% AEP 382 m^3/s
- 2% AEP 319 m^3/s
- 5% AEP 237 m^3/s
- PMF 1910 m^3/s

AEP is Annual Exceedence Probability and indicates the chance of a particular flood event occurring in any one year. That is a 5% AEP has a 5% chance (i.e. a 1:20 chance) of occurring in any one year. The peak flows as calculated within the 2004 report have been adopted within this report, no calculation or design review was undertaken as part of this report.

Figure 4, below, is an extract from the 2004 Flood Study which includes the subject site. The information presented indicates that Dumaresq Street in front of the proposed motel development was not inundated by flood waters in either of the flood events presented.

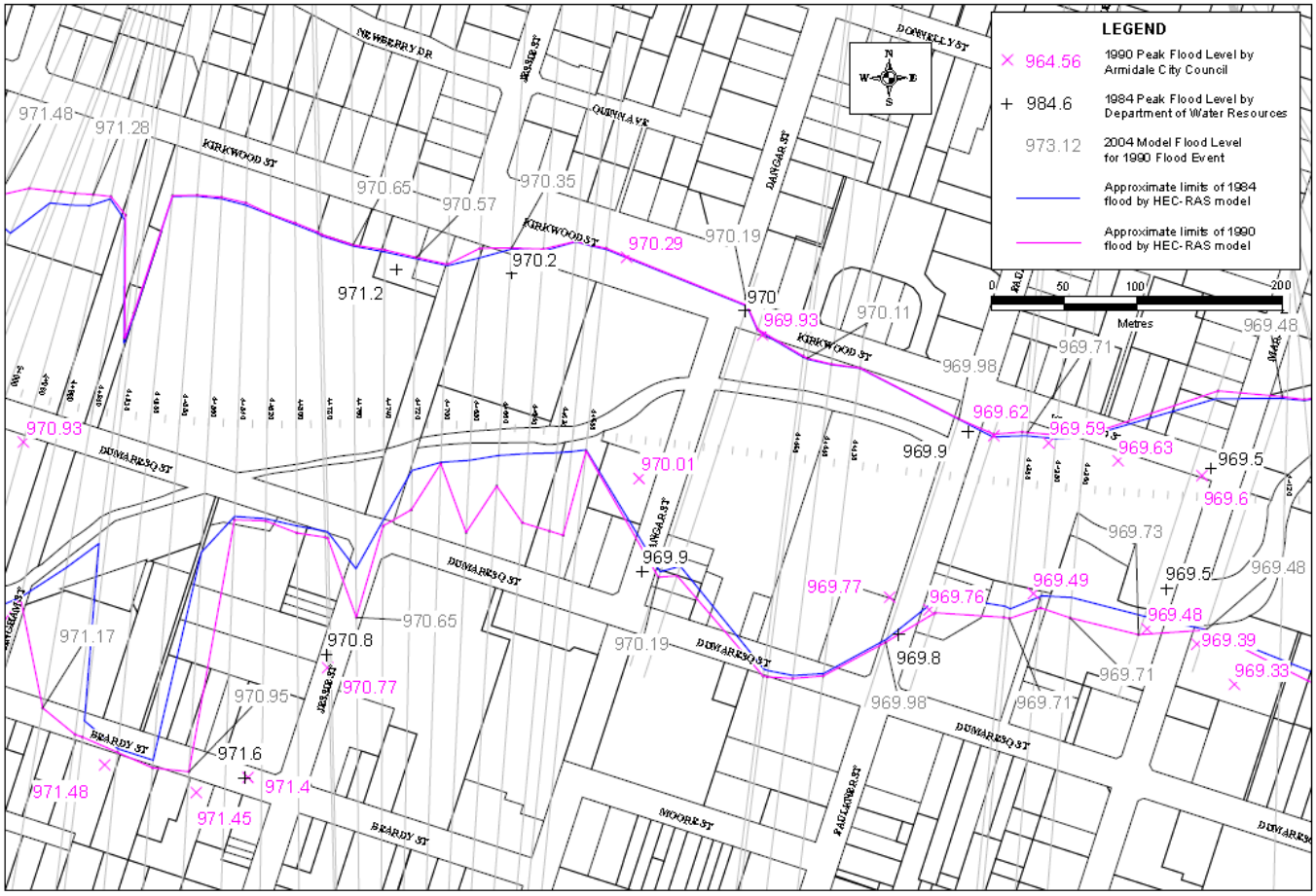


Figure 4 – Armidale Flood Study 2004 Extract

Details of the flood planning requirements were provided by Council. Figure 5 below, shows the approximate levels of the Probable Maximum Flood (PMF) and the Flood Planning Level (FPL).

The PMF is shown as the red dashed line with the FPL shown as the blue dashed line. The Flood Planning Level is the approximate flood water level 500 mm above the 1% AEP storm event. That is, a freeboard level of 500 mm above the 1% AEP flood level.

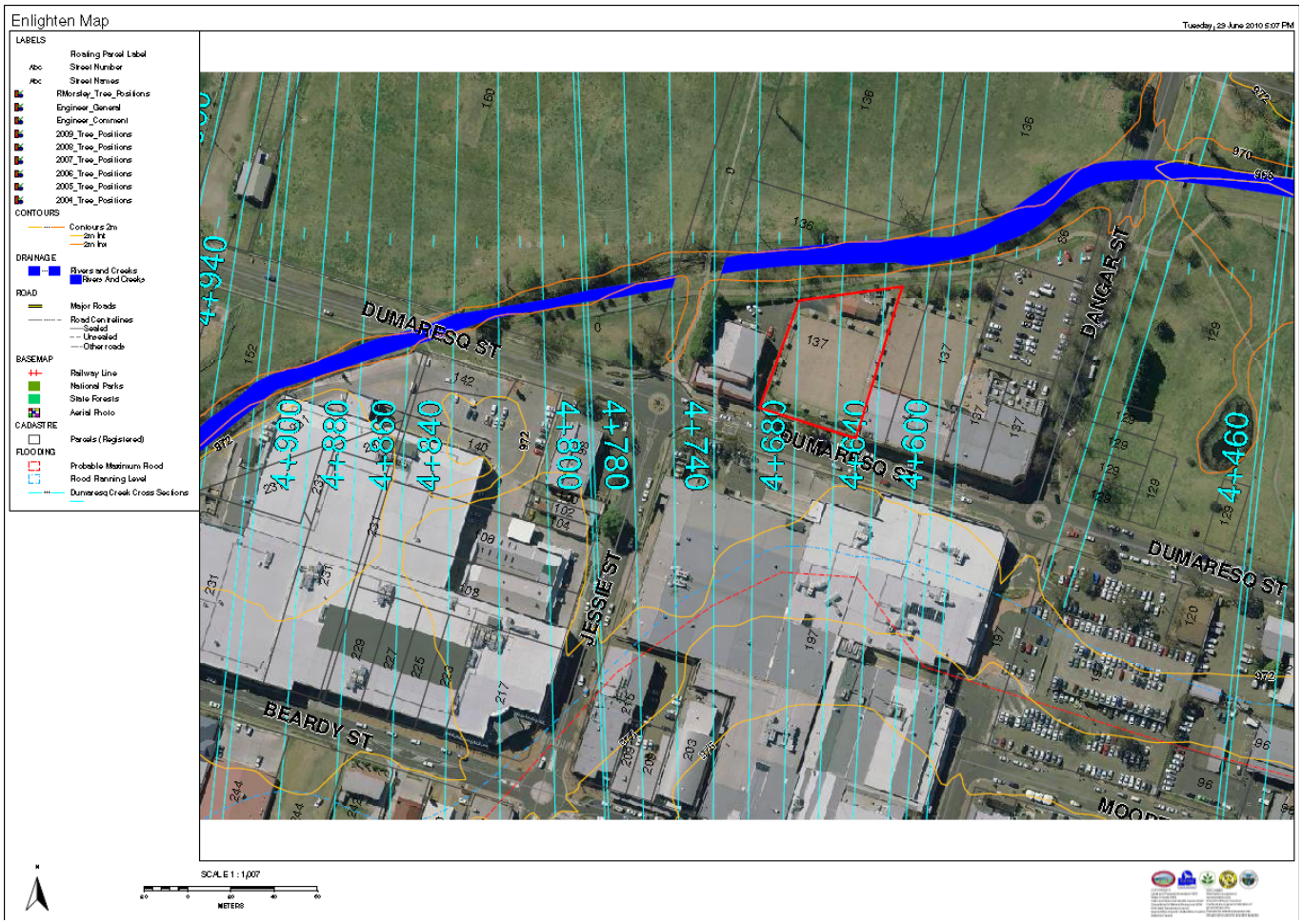


Figure 5 – Armidale Dumaresq Council Flood Planning Information

3. FLOOD MODELLING & HYDRAULIC REVIEW

3.1 Background

The proposed motel development will be undertaken within a flood prone area as identified within the Armidale Flood Study 2004 prepared by Armidale Dumaresq Council. An extract of the extent of flooding against Council's GIS map for the proposed development site is provided in Appendix C.

3.2 Flood Modelling for the Proposed Development

An extensive review of all available data and a walk over the site by an experienced engineer was carried out to determine the flood water levels for the proposed development site during the major storm events.

The HEC-RAS model provided by Armidale Dumaresq Council was modified to suit the detailed survey information available for our site and the blockage resulting from the proposed development was added. Only very minor changes to the initial model were required, based on the detailed survey information, as the existing HEC-RAS cross sections were found to be very accurate. A summary plot of the HEC-RAS results for the 1% AEP storm event is shown in Figure 6, below.

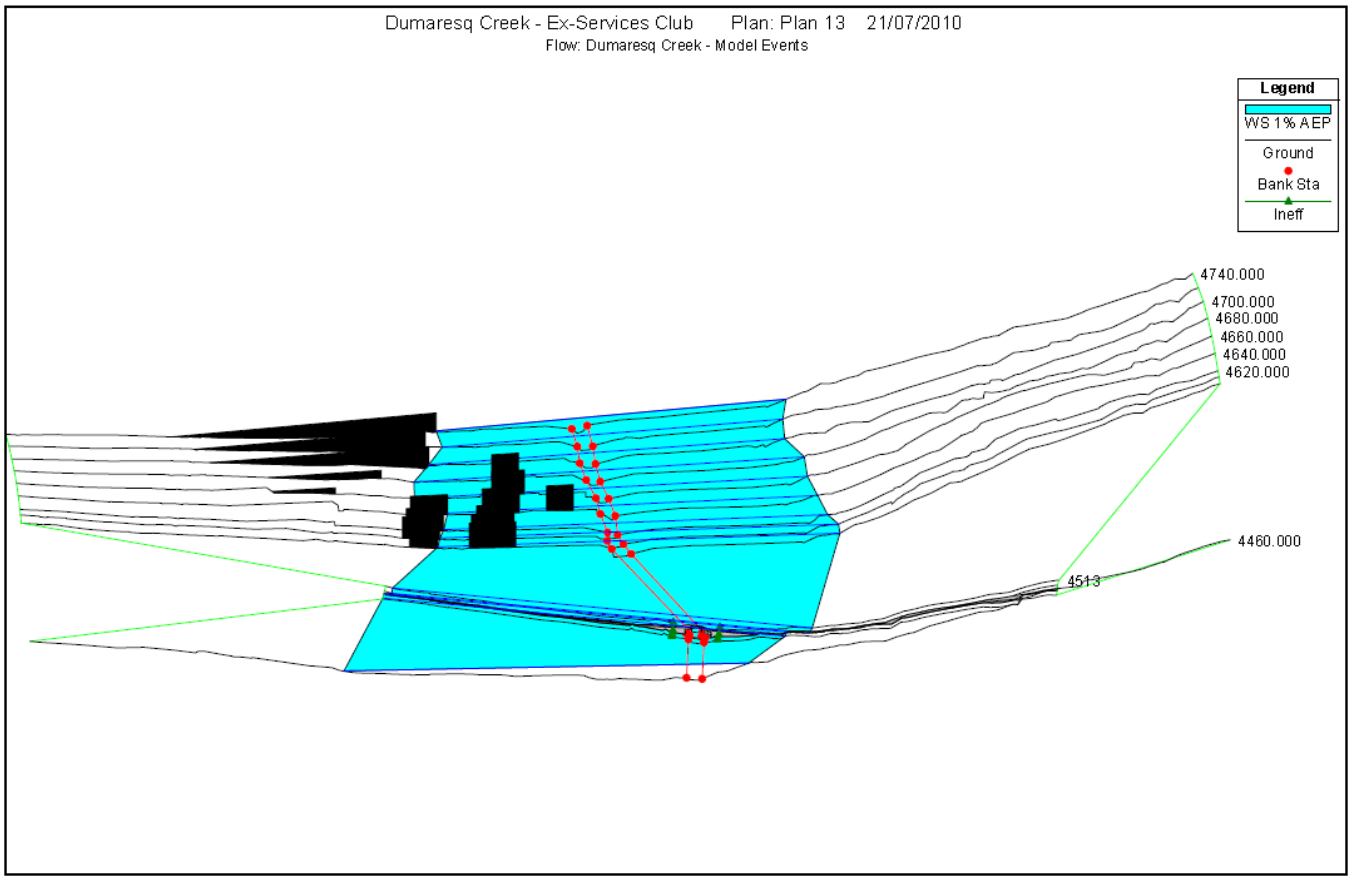


Figure 6 – HEC-RAS Post-Development Results Plot for 1% AEP (1:100 Year) Storm Event

A summary of the pre and post-development flood levels for the critical storm events as calculated from the HEC-RAS model is provided in Table 1 below. The post development levels are based on levels for Stage 2 of the proposed development as shown on the architectural documentation. Flood modelling of Stage 1 & 3 works was not undertaken as the works for Stage 2 incorporate changes to floor footprint for all three stages.

River Station Reach BR-1	Pre-Development RL (AHD) Storm Event				Post-Development RL (AHD) – Stage 2 Storm Event			
	1% AEP	2% AEP	5% AEP	PMF	1% AEP	2% AEP	5% AEP	PMF
4720	971.44	971.23	970.96	973.68	971.43	971.22	970.96	973.67
4700	971.40	971.18	970.91	973.64	971.40	971.18	970.91	973.66
4680	971.39	971.16	970.88	973.69	971.39	971.16	970.89	973.68
4660	971.37	971.14	970.86	973.69	971.37	971.15	970.86	973.72
4640	971.34	971.11	970.83	973.63	971.34	971.11	970.83	973.63
4620	971.34	971.10	970.82	973.63	971.34	971.10	970.82	973.63
4609	971.33	971.10	970.81	973.62	971.33	971.10	970.81	973.62
4600	971.32	971.09	970.80	973.62	971.32	971.09	970.80	973.62

Table 1 – Pre & Post-Development Flood Level Comparisons
(Extent of the proposed development shown shaded)

A detailed summary of the HEC-RAS output from the site specific modelling for the post-development configuration that will occur at the completion of the Stage 2 works may be found in Appendix D of this report.

3.3 Floor Levels for the Proposed Development

The proposed redevelopment site is located between the HEC-RAS river stations of 4640 to 4680, the critical cross section for minimum floor levels has been adopted as river station 4700 (conservatively adopted upstream of development). The proposed development has had minimal impact on the flood levels as demonstrated in Table 1 with the majority of levels remaining unchanged.

In the initial meeting with Council they advised that the flood levels calculated in the 2004 Flood Study may need to be increased by up to 80mm due to the impact of the Centro Development upstream. Following the second meeting with council this requirement was reviewed further, with Council providing a summary extract from the 2006 Tierney & Partners flood report for that development. The summary indicated that the Centro Development

did not have any impact on the downstream flood levels at the proposed development site. A copy of this summary extract may be found in Appendix E of this report.

Based on Table 1, above, it can be seen that the post-development 1% AEP flood level is 971.40 AHD at river station 4700. Hence, for the subject development the appropriate flood planning level is FPL = 971.90 AHD, being 500 mm above the 1% AEP flood event.

3.4 Flood Impact on the Proposed Development

The bulk earthworks levels proposed for the development site lift the level of the front of the site along Dumaresq Street with the remaining ground levels to approximately match the existing surface levels. The construction of the building envelope at the front of the site has minimal impact on flood behaviour as the building is located behind the existing Cinema building which is constructed on ground. The rear of the Cinema complex is constructed as a suspended slab to allow the flood waters to pass under the structure. The proposed motel development carpark is located adjacent to this area of the Cinema building with slab levels matching approximately at existing or natural ground levels.

In the developed state the storm events from the 10% AEP to the 1% AEP will exceed the capacity of the existing Dumaresq Creek channel running along the rear of the site. The resultant overland flows will continue through the development site and discharge over Dangar Street in a similar fashion and location to the pre-developed site. Hence, all overland flows are maintained through the proposed development site and not forced around the site.

Figure 7, below, shows the typical HEC-RAS cross section of the developed site with the flood waters breaking the banks of Dumaresq Creek for the 10% AEP storm event (1:10 year storm).

Cross sections details for all of the storm events from the 20% AEP to the 1% AEP may be found in Appendix F of this report.

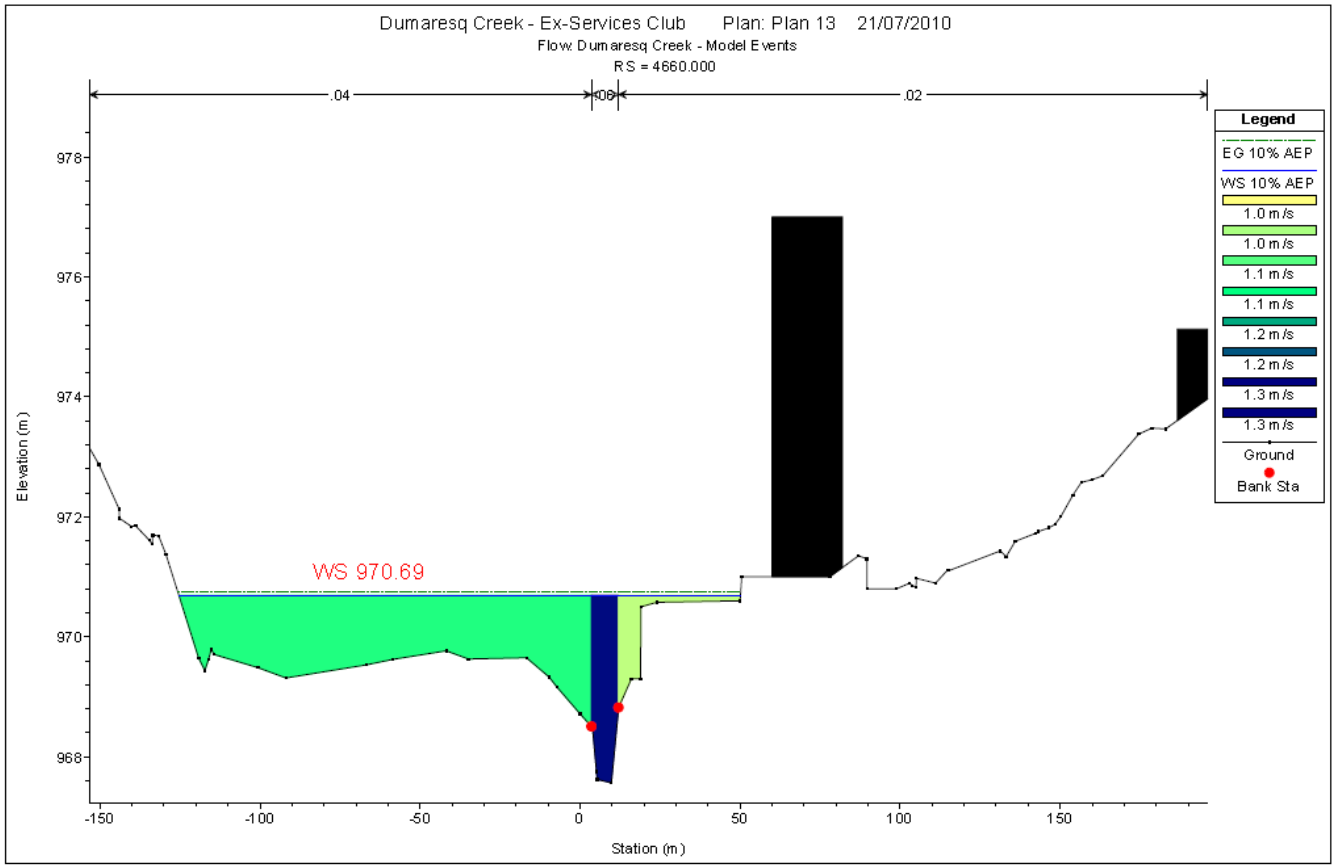


Figure 7 – HEC-RAS Post-Development Cross Section Results for 10% AEP (1:10 Year) Storm Event

4. RISK ASSESSMENT FOR THE PROPOSED DEVELOPMENT

4.1 Background

The risk assessment approach is based on assessing the risk or likelihood of recurrence of varying floods based on specified rainfall intensities. Flood inundation and high velocity flows are a threat to the local community. The risk of those assets being lost depends on the extent and volume of floodways, flood storages and flood fringes.

4.2 Review of Site Hazard Classification

Flood inundation maps for the Armidale townships have been prepared by Armidale Dumaresq Council for 1% AEP and PMF flood events. The NSW Floodplain Development Manual defines flood zones into three categories, namely, “floodways”, “flood storage” and “flood fringe”. Each of these is summarised below:

- Floodways are areas of significant flow paths that should be kept free of obstructions, else upstream flood levels may increase.
- Flood storage areas hold significant volumes of water during floods and should not be filled else downstream flood discharges may increase.
- Flood fringe areas are inundated but convey no significant amounts of flood and hold not significant storage. These areas can be developed and filled without adversely affecting flooding.

The flood hazard for the site has been reviewed in accordance with the Floodplain Development Manual, an extract Figure L2 – Provisional Hydraulic Hazard Categories has been reproduced in Figure 8, below.

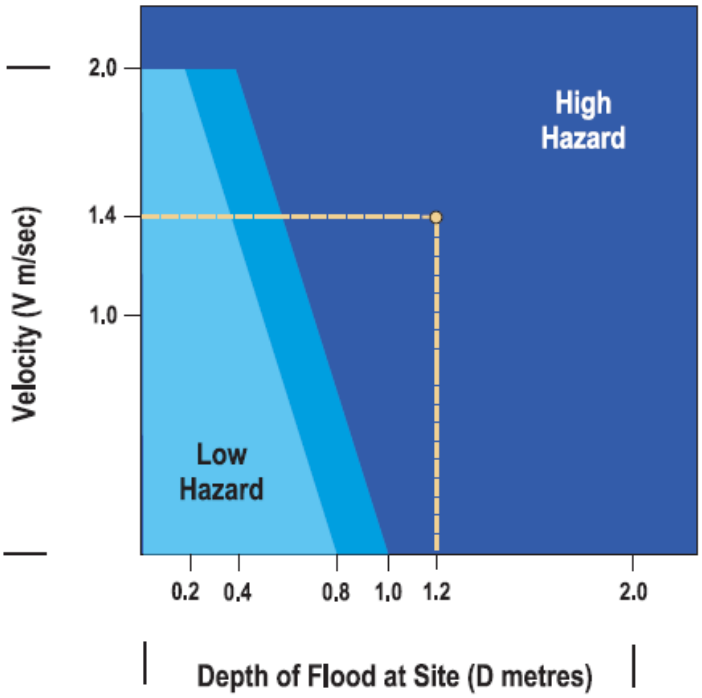


Figure 8 – Provisional Hydraulic Hazard Categories

The Provisional Hydraulic Hazard Categories have been developed as guidelines to be used in conjunction with appropriate site flood studies to determine the likely impact of flooding on property and personnel safety. Figure L2 from the Floodplain Development Manual, an extract Figure L2 – Velocity & Depth Relationships has been reproduced in Figure 9, below.

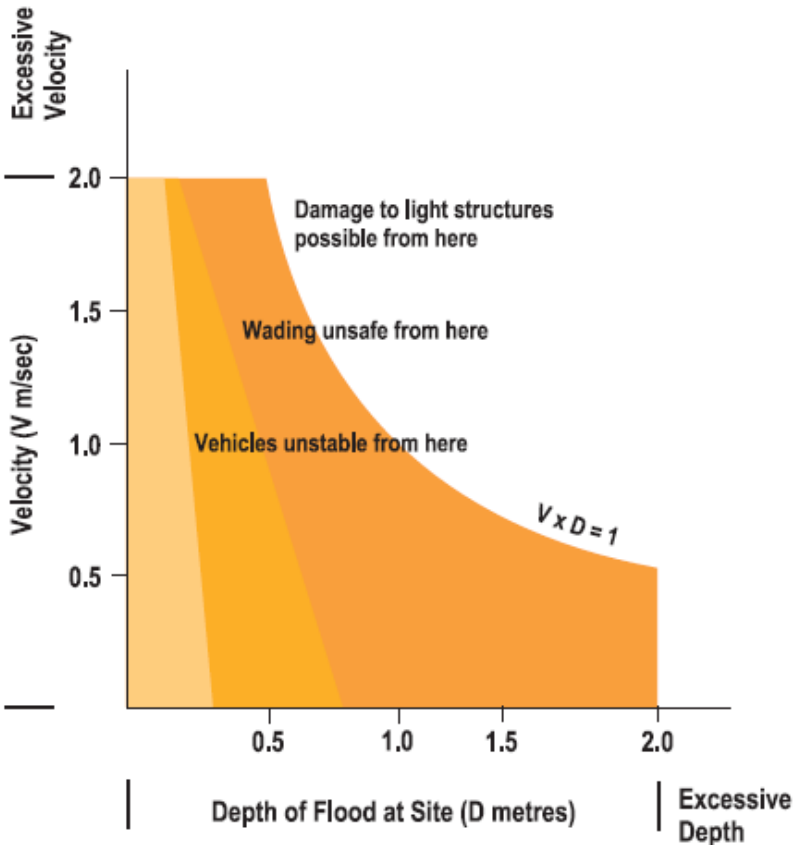


Figure 9 – Velocity Depth Relationships

Based on the above information & the detailed analysis carried out in the flood study it is possible to provide guidance on the Flood Hazard Categorisation for the subject development. This then allows the development of a suitable flood response plan to be developed for the subject site in the event of a major flood event.

4.3 Site Hazard Classification

The proposed development site backs onto Dumaresq Creek and is obviously subject to rising floodwaters from the rear of the property. In addition, in more severe flood events the upstream flood waters will split at the Jessie Street round-a-bout directing flood water away from the main channel & down Dumaresq Street.

The critical floodway for the subject site is Dumaresq Creek, located to the rear of the development site. Based on Figure 8, above, it can be seen that even for minor flood events Dumaresq Creek is considered a High Hazard Floodway due to the depth of flood water exceeding 1.2 metres in depth.

The flooding associated with Dumaresq Street is not as significant as the flooding to the main creek channel to the rear of the development site. Table 2, below, provides a summary of the comparison of the Dumaresq Creek flows pre & post-development.

River Station Reach BR-1	Pre-Development			Post Development		
	Vel Chnl (m/s)	Flow Area (m^2)	Top Width (m)	Vel Chnl (m/s)	Flow Area (m^2)	Top Width (m)
4700	1.32	301.59	238.78	1.36 (1.03)	290.02 (0.96)	224.74 (0.94)
4680	1.15	335.90	254.52	1.21 (1.05)	320.94 (0.96)	241.82 (0.95)
4660	1.08	349.01	259.07	1.14 (1.06)	328.02 (0.94)	236.55 (0.91)
4640	1.05	321.00	211.05	1.08 (1.03)	314.24 (0.98)	210.00 (1.00)
4620	0.98	357.00	231.38	0.97 (1.01)	358.68 (1.00)	231.39 (1.00)
4609	1.01	370.21	240.96	1.01 (1.00)	370.21 (1.00)	240.96 (1.00)
4600	1.03	371.80	237.32	1.03 (1.00)	371.80 (1.00)	237.32 (1.00)

Table 2 – Floodway Channel Characteristics for 1% AEP
Numbers Shown in (brackets) Ratio of Pre to Post Development
(Extent of the proposed development shown shaded)

There are minimal level changes proposed for the proposed car park in the area designated as High Hazard floodway, therefore there will be no net loss in flood storage. Based on Table 2 above, it is evident that the existing channel has only minor impact on the existing flow characteristics, typically less than 5% change.

Table 3, below, provides a summary of the Flood Hazard parameters in Dumaresq Street at River Station 4660, located in front of the proposed development site:

Flood Event		Dumaresq Street Flood Waters		Flood Hazard Category
AEP	Return Period	Depth (m)	Velocity (m/s)	
20%	1:5	0	0	N/A
10%	1:10	0	0	N/A
5%	1:20	0.060	1.11	LOW Hazard
2%	1:50	0.350	1.17	LOW Hazard
1%	1:100	0.570	1.25	INTERMEDIATE Hazard

Table 3 – Dumaresq Street Flood Hazard Categorisation

Flood inundation mapping has been completed for the 20%, 5%, 2% and 1% AEP flood events for the proposed development site in order to provide a basis for the flood response plan. Figures 10 to 13, below, show the flood water depths across the site for the nominated storm events.

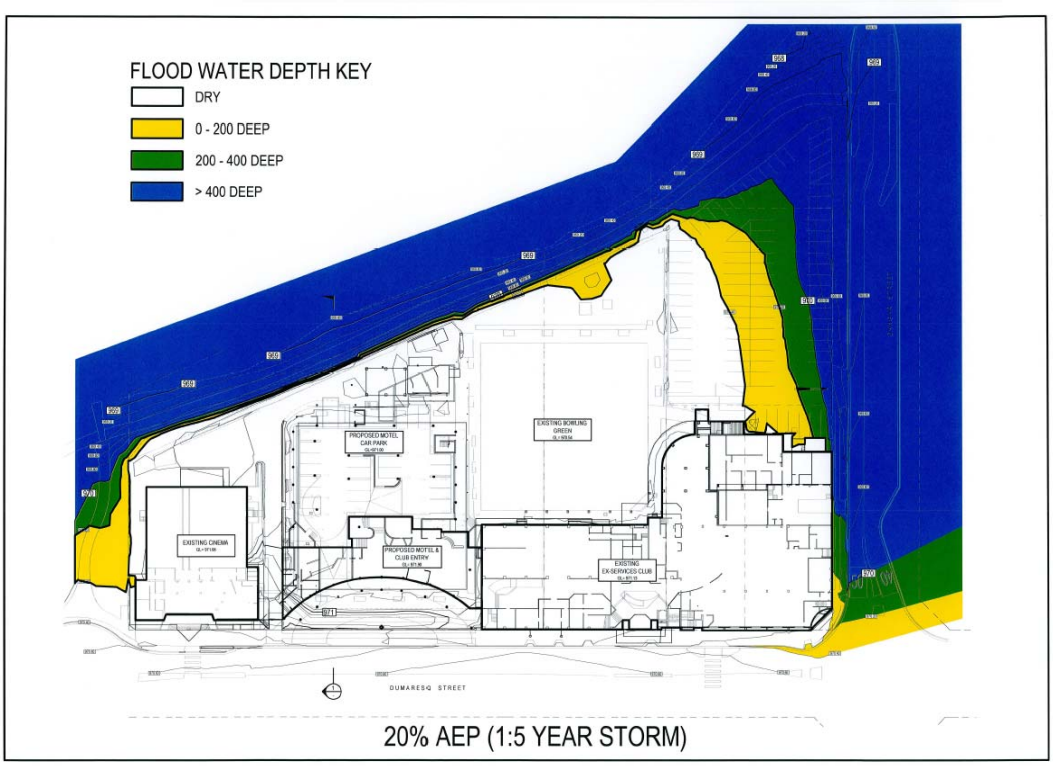


Figure 10 – Flood Water Inundation 20% AEP Flood

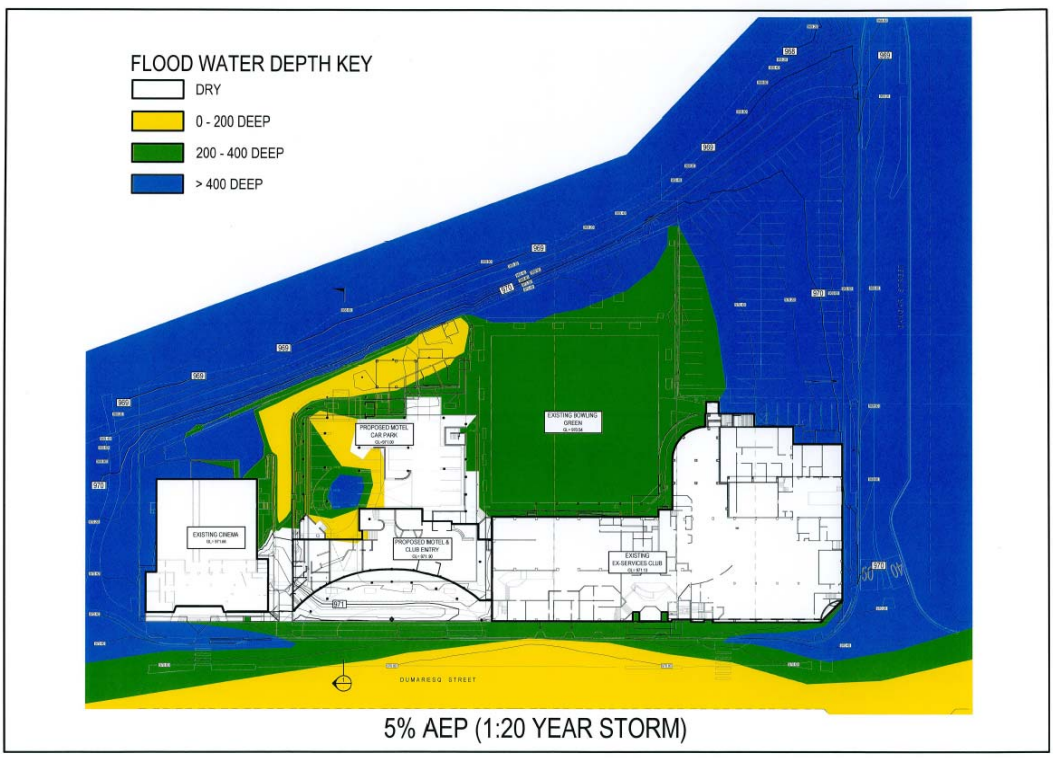


Figure 11 – Flood Water Inundation 5% AEP Flood

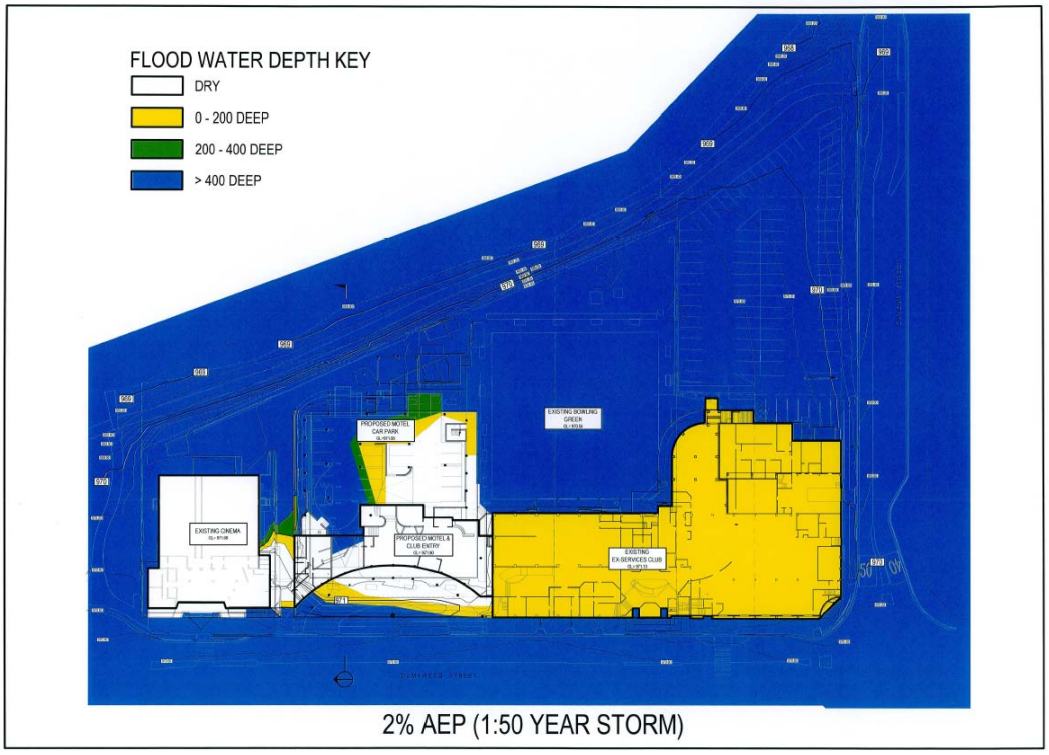


Figure 12 – Flood Water Inundation 2% AEP Flood

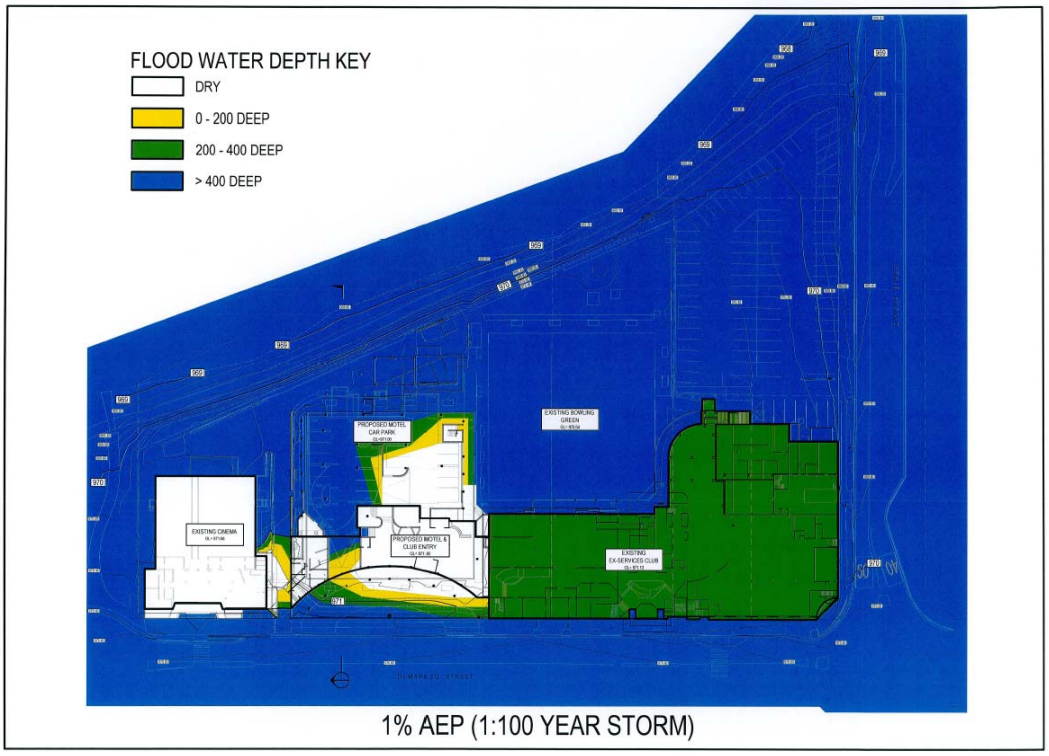


Figure 13 – Flood Water Inundation 1% AEP Flood

Larger scale versions of the flood inundation maps have been provided in Appendix G of this report.

Hence, based on the above information, the following is a summary of the flood hazard levels for the 1% AEP flood event (1:100 year):

- Dumaresq Creek : High Hazard Floodway
- Dumaresq Street : Intermediate Hazard Floodway/Flood Fringe

Based on the above hazard classification flood evacuation is not feasible during the peak of the 2% AEP (1:50 year) storm event and less frequent storms. Hence the emergency response for the site for the large storm events will be to provide refuge on site within the motel building.

4.4 Structural Certification

The structural design of the project has not been undertaken at this time. The structural design brief for the development includes the additional requirements imposed by the potential flood water inundation on the site.

The project structural engineer shall provide at Construction Certificate stage a structural design certificate stating that the building will not sustain structural damage from the water forces, impact of debris and the effect of buoyancy during a flood rising to the PMF flood level.

4.5 Building Construction Requirements

All building materials used below the PMF level will be suitable for immersion in flood waters. The following building controls shall be in place to minimize flood damage:

- Electrical wiring and outlets to be located a minimum of 1000mm above the 1% AEP flood level of RL 971.4 m AHD where possible. All electrical wiring installed below this level shall be suitable for submergence in water.
- All sewers are installed with overflow/surcharge protection up the PMF flood level of RL 973.66 AHD. Detailed design to be prepared by the Hydraulic consultant at Construction Certificate issue to the approval of Armidale Dumaresq Council.
- Any openings under the building/carpark shall be suitably screened for security (vertical galvanised bars at 125 mm centres), without disrupting the flow of stormwater.
- Floor coverings shall be water resistant.
- There shall be no hazardous materials stored at this site.

5. ARMIDALE DUMARESQ COUNCIL LEP 2008 COMPLIANCE

5.1 Background

The Armidale Dumaresq Local Environment Plan 2008 Part 3 Special Provisions deals with the development of land below the flood planning level. The following items are the objectives of the clause:

(a) to maintain the existing flood regime and flow conveyance capacity, and
(b) to enable safe occupation of land below the flood planning level, and
(c) to avoid significant adverse impacts on flood behaviour, and
(d) to avoid significant adverse affects on the flood plain environment that would cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of the river bank or watercourse, and
(e) to limit uses to those compatible with flow conveyance function and flood hazard.

5.2 Impact on Existing Flooding Regime

The proposed development has been modelling using HEC-RAS to determine the impact of the proposed construction works on the flood waters. Table 1 in Section 3.2 demonstrates that the construction of the proposed development has no impact on the depth of the flood waters in Dumaresq Creek or Dumaresq Street. Table 2 in Section 4.3 demonstrates that the construction of the proposed development has a minimal impact (3 to 6% increase) in the main channel floodwater velocity locally over the area of the proposed development. Upstream & downstream of the proposed development the flood water velocities remain unchanged.

5.2 Safe Occupation of Land Below the Flood Planning Level

The proposed development has the following general site levels:

- Street Frontage : Varies 971.1 to 971.75
- Habitable Floors : 971.90
- Carpark : Varies 970.50 to 971.83
- Access Driveway : Varies 971.1 to 971.75

The flood planning level for the site has been set at FPL = 971.90 in Section 3.2 of this report. Based on the above it can be seen that the only areas below the flood planning level are the carpark and external driveway & access areas.

5.3 Impact of the Proposed Development on Flood Behaviour

Based on Sections 3 & 4 of this report, it has been demonstrated that the proposed development does not have any significant impacts on the behaviour of the flood or flood waters. Some slight increases in the channel velocities were noted, but these are much localised to the proposed development & do not pose any adverse impacts on any adjacent developments or properties.

5.4 Impact of the Proposed Development on the Flood Plain Environment

The proposed development does not involve any major modifications to the existing site levels adjacent to the existing creek.

Stage 2 of the proposed development does involve the construction of a new 6.2 metre wide access driveway along the Dumaresq Creek alignment, at the rear of the development. Preliminary design work for this roadway was based on a suspended slab to minimise the impact on the flood storage volume. During the meeting on 25 June 2010, Council indicated that it would be preferred if the extension to the roadway was not suspended, instead supported by a retaining wall along the creek alignment. The flood storage volume reduction was not considered an issue due to the large expanse of flood storage currently available in Harris Park on the northern side of Dumaresq Creek.

5.5 Impact of the Proposed Development on Flow Conveyance Function & Flood Hazard

As noted in section 5.4, above, the proposed development does not have any significant impacts on the flow conveyance of the flood waters nor does it in any way change the flood hazard categorisation of the site or any upstream or downstream properties.

6. REVIEW OF FLOODPLAIN DEVELOPMENT MANUAL

6.1 Background

As part of the review of the proposed development a review of the Department of Infrastructure, Planning and Natural Resources publication Floodplain Development Manual dated April 2005 has been undertaken. The aim of this review is to ensure that the proposed development is able to comply with the suggested guidelines of the above publication to enable Council to approve the proposed development which is located on land that is prone to flooding.

6.2 Flood Study

The Armidale Flood Study 2004 has been used as the basis of this review. The HEC-RAS modelling used in the report has been modified to include the impact (floodwater flow blockage) that the proposed development will cause. The pre-development & post-development outcomes were then compared to determine the impact of the development on the flooding.

The flood study provides for all storm events from the 20% to the 1% AEP storms and also includes the probable maximum flood or the PMF.

6.3 Hazard Categorisation

The flood study that has been carried out has determined that the proposed development site has two different Flood Hazard Categories, as summarised below:

- Dumaresq Creek : During all flood events this is a HIGH HAZARD floodway
- Dumaresq Street : During the 20% & 5% AEP this is LOW HAZARD flood fringe
  During the 2% AEP this is LOW HAZARD floodway or flood fringe
  During the 1% AEP this is INTERMEDIATE floodway or flood fringe

6.4 Effective Warning Time & Alert Systems

The effective warning time available is the time from when an imminent flood event is identified until the time that the effected people can be notified.

Armidale Dumaresq Council maintain a flood warning system based upon the continuous automatic monitoring of the depth and rate of rise of water in Dumaresq Creek measured at a number of strategic locations along the creek. The main monitoring station is located at Stephens Bridge on Marsh Street, downstream from the subject development site.

The warning system that Council has in place is based on a series of alerts which are summarised below:

- **First Alert :** When the water at Stephens Bridge reaches a gauge level of 0.7 metres, protection alert is issued by phoning the Works Coordinator

- **Second Alert :** When the water at Stephens Bridge reaches a gauge level of 0.85 metres, temporary road closure alert is activated. The roads are to be closed in the following order:

    - Beardy Street West (Martins Gully)
    - Taylor Street
    - Faulkner Street
    - Dangar Street
    - Dumaresq Street near Cinema
    - Cooks Road
    - Marsh Street at Stephens Bridge

    When council staff starts closing the above roads, a member of council staff physically meet Cinema staff to make them aware of possible flooding. It is then up to Cinema staff to monitor the situation and institute any necessary evacuation.

- **Third Alert :** If the water continue to rise and reaches 2.7 metres at Stephens Bridge, the protection alert is issued to the State Emergency Services (SES)

- **Fourth Alert :** When the water at the downstream Dumaresq gauging station reaches a gauge level of 1.85 metres, a flooding alert is issued to the SES. From Council experience a level of 1.85 metres at this downstream gauging station will result in a level of approximately 2.9 metres at the Stephens Bridge two hours later and cause low level flooding in Beardy Street near the new Woolworths complex.

A copy of the Armidale Dumaresq Council flood warning system update used in the preparation of this report may be found in Appendix H.

6.5 Duration of the Flooding

The Armidale Flood Study 2004 concluded that the critical storm event for the critical catchments to Dumaresq Creek is the 9 hour storm. Based on discussions with Council staff the peak flood water levels in Dumaresq Creek would be expected to be reached within 4.5 to 9.0 hours of the storm event commencing. It is also expected that the recession of the flood waters would also take place over a similar time frame for the most severe storm event.

Due to this duration of the critical storm event, the key factors of flood inundation on trapped occupants are not critical for the proposed development site. These include:

- Post-event anxiety and trauma-related disorders
- Shortages of water or food
- Medical emergencies

The effective warning time for the large storm events allows for decisions to be made about the site evacuation prior to flood waters arriving. Flood and flash flood warning are provided by the Bureau of Meteorology and typically have a lead time of at least 6 to 8 hours. If very large storm events are forecast the site warden responsible for implementing the emergency response would have adequate time, typically in the order of 8 to 12 hours, to decide if a site evacuation is required. If the evacuation of the site is not practical for any reason the adoption of the on-site refuge policy may be implemented.

The following issues are seen as the main points that require review to ensure that the on-site refuge policy may be adopted adequately:

- Back-up power supply for lighting
- Potable water supply
- Food supply
- Medical emergency evacuation
- Preventing guest self-evacuation of their motor vehicles during the peak of the storm event

These issues have been reviewed and addressed at section 6.9, below.

6.6 Limitation of Evacuation Problems

The positioning of the development site adjacent to Dumaresq Street with paved roads to higher ground eliminates the majority of issues related to flood evacuation of the site. The following aspects of the development will assist in the evacuation in the event of a major flood event such as the 1% AEP storm event or larger floods:

- The depth of flood waters in Dumaresq Street in the 1% AEP storm event will be less than 0.6 metres deep with a velocity less than 1.3 metres per second. Under this extreme flooding event these flood water conditions can be waded through safely by the development occupants & emergency staff.
- The evacuation route is fully sealed with even grades for safe access even when partially flooded.
- The distance to flood free ground is relatively close, being within half a block from the motel entrance.

6.7 Effective Flood Access

An effective access route from a development is one that remains trafficable for sufficient time to evacuate people and possessions. This also includes other appropriate boat-based or air-based means of evacuation.

The proposed development provides suitable egress along Dumaresq Street to Dangar Street for both pedestrians & vehicles, except during the peak of the major storm events. The existing Council Flood Warning System already

provides both telephone and direct personnel contact to the adjacent cinema complex, in the event that the flood early warning monitoring systems are activated.

If the decision is made to evacuate the site, prior to flood waters inundating the site, then clear road egress is provided to Dumaresq Street during Stage 1 of the development and to Dangar Street after Stage 2 of the project. Any evacuation of the site would be carried out in conjunction with emergency personnel such as the State Emergency Services to ensure that adequate time to complete the evacuation has been allowed.

6.8 Type of Development

The proposed development incorporates a five star motel complex with associated car parking on the ground & first floor levels. The threats of flood inundation of the site can be managed by this type of development as follows:

- The 5-Star motel will have a 24 hour serviced reception area for monitoring of any warnings or alerts issued by Council's flood warning system
- The reception staff have direct communication access via phone & PA systems to all guest rooms
- The reception staff have master key access to all guest rooms
- The motel concierge will have access to all vehicle keys for cars parked in the motel carpark, enabling them to relocate cars to higher levels within the carpark in the event that flood warnings are issued
- Adequate potable water supplies are available in the adjoining club facilities
- Emergency back-up power supply will be available to ensure that lighting and any other emergency monitoring equipment has a power supply at all times

6.9 On-site Refuge Policy

The proposed policy of having on-site refuge during major or critical storm events relies on the motel complex being a suitable safe haven for the staff and guests who will be required to remain on site for the duration of the storm event. The following is a summary of the proposed measures that will be required to ensure that the motel development will provide safe refuge and minimise any associated dangers of adopting the on-site refuge policy:

- Back-up power supply for lighting: A back-up power supply to run the emergency lighting system & other essential services such as communication systems is readily able to be installed in the proposed development. It is not considered necessary for the back-up power supply to provide power for heating, lifts or cooking facilities, due to the relatively short duration of confinement, which would be less than 24 hours..
- Potable water & food supply: The club facilities adjoining the proposed Motel development provide adequate food and bottled water supplies for the staff & guests. Non-perishable food and water bottled supplies will be available from both the ground and first floor restaurant facilities.
- Medical emergency evacuation: It is considered to be a low probability that a medical emergency requiring urgent medical assistance would occur during the flood event, with a probability of around 5% being

considered a conservative estimate. During a medical emergency the following options would be available to the guests & staff:

- The warden can supply emergency first aid until emergency services arrive.
- Emergency personnel, such as the SES, can access the front of the building using 4WD or trucks that are capable of driving through the flooded streets, even in the 1% AEP storm event.
- In the worst case storm event, such as the PMF event, emergency personnel could access & evacuate the critical patient by helicopter or boat. It may be considered necessary for the motel development to provide a rescue boat stored on site for use by the SES in such an extreme emergency.

- Preventing guest self-evacuation of their motor vehicles during the peak of the storm event: It is important to prevent guest vehicles from being removed from the car park and driven to the rear of the property adjacent to Dumaresq Creek prior to exiting in Dangar Street during any significant storm events. This area is a high hazard floodway area and not suitable as an emergency egress route during any significant flood events above the 10% AEP storm event (1:10 year storm). Control of the guest carpark will be expected to be via a security card boom gates arrangement. Desperate guests may resort to driving vehicles through boom gates in an attempt to exit the carpark only to be caught in rising flood waters along Dumaresq Creek. It is considered necessary to provide removable security bollards at the exit points to prevent any such unauthorised exiting from the carpark. When a flood emergency is announced the boom gates should be locked off & the bollards installed to prevent any vehicles leaving the carpark area.

6.10 Alternative Evacuation Option

During discussions with various Council officers during meetings and phone conversations the option of alternative evacuation methods has been explored. The main option discussed was a high level pedestrian bridge from the first floor level of the club building across to the Armidale Plaza building on the southern side of Dumaresq Street.

Based on the on-site refuge policy proposed for the development the bridge proposal is not considered necessary for the proposed development. The following issues are also raised with this proposed option:

- Cost prohibitive nature of the bridge: the cost of constructing the pedestrian bridge would be prohibitive and most likely prevent the motel development proceeding.
- Link Issues with Armidale Plaza Building: The proposed bridge would involve a link to the main shopping level of the Armidale Plaza building. This would impact of the existing tenants who include Kmart, Crazy Clarks, Target Country and amenities areas along the possible link areas. From a preliminary inspection it would also appear that whilst adequate height can be achieved from the club building that the Armidale Plaza floor level is lower & would require additional descending ramps to be able to link to the bridge structure.

Hence, based on the above it is not considered feasible to provide a high level access from the club building to the Armidale Plaza building.

7. FLOOD EMERGENCY PLAN

7.1 Background

As part of the development approval process Council will require the submission & approval of the site specific Flood Emergency Plan. The plan is implemented with the following aims:

- Clearly identify the on-site refuge policy being adopted for the proposed development
- Clearly identifies the responsible person or persons within the motel and their contact & emergency contact telephone numbers.
- Details of the Council flood warning system and the warnings & alerts that will be issued.
- Details the actions required by the responsible person or persons when a warning or alert is issued .
- Details the actions to be taken in an extreme flooding event, which may include evacuation of the site if extreme flood events are forecast and adequate evacuation time is available.

7.2 Site Specific Flood Emergency Plan

A site specific flood emergency plan has been prepared for this proposed development. The plan should be seen as a starting point for the proposed development and subject to review by the local authorities and the motel management.

The plan, like any form of response planning, is unreliable as a long term risk mitigation measure. Floods are highly variable in frequency and severity which directly influences two critical planning assumptions, available flood warning time and likely consequences.

A copy of this plan & the flood inundation map may be found in Appendix I of this report.

8. CONCLUSIONS

The proposed motel development is located within land designated as flood prone by the Armidale Flood Study 2004. The rear of the development is located within a high hazard floodway zone as identified within this report.

The proposed development requires minor filling of the site to meet floor free board requirements along the existing road level on the Dumaresq Street side of the site. All existing overland flows that currently traverse the site are maintained within the proposed development. The upstream & downstream properties were not found to be adversely effected by the proposed development.

Based on investigations, design review and calculations undertaken as part of this Flood Report the minimum floor level for the proposed motel development was calculated to be RL 971.90 m AHD, providing a freeboard of 500mm to the calculated 1% AEP as required by Council.

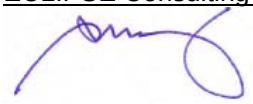
A review of the relevant Council LEP was carried out to confirm that the proposed development does meet with the requirements of the LEP and hence make it suitable for approval. Due to the inundation of Dumaresq & Dangar Streets in major storm event an on-site refuge policy has been adopted for the motel development in the event that inadequate time is available for a site evacuation.

A site specific Flood Emergency Plan for the site has been developed along with a Flood Zone Map that clearly identifies the expected flood water inundation for the extreme “1:100 year flood” event. A Flood Evacuation Route has also been provided in the event that extreme flooding is predicted & emergency services are recommending evacuation of the motel.

Due to the type of building and its proposed use, combined with the building controls, Flood Emergency Plan and flood damage reduction procedures, the new development can be successfully used for its intended purpose within the Armidale Flood Prone Area.

Please feel free to contact the undersigned should you require any additional information or clarification of any of the items in the preceding report.

Yours faithfully,
ECLIPSE Consulting Engineers Pty Ltd



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