

Wagga Wagga City Council
PO Box 20
WAGGA WAGGA NSW 2650

11100702/L121113_GumlyFIA

13 November 2012

Attention: Mr Ian Grant

Dear Ian,

**Re: Flood Impact Assessment –
Eastern and Southern Portion of the Proposed Enterprise Corridor, Gumly Gumly**

1. Executive Summary

This Flood Impact Assessment has been prepared in relation to the proposed rezoning of land at Gumly Gumly where Council seeks to rezone a precinct of land from RU1 Primary Production to B6 Enterprise Corridor. In doing so, it is likely that ground levels will need to be raised to meet floor level and planning requirements. To assess the impacts of the raised ground levels hydraulic modelling was undertaken.

The existing hydraulic model for the Murrumbidgee River at Wagga Wagga, originally prepared as part of the Murrumbidgee River Model Conversion Project 2010, was re-established so that two concept designs could be run to identify the significance of the proposed rezoning in terms of flood risk. This study considers the flood related impacts of raising land within the Subject Site in addition to the raising of land already assessed as part of a previous Flood Impact Assessment undertaken for an area of land north of the Sturt Highway (Reference 1). The modelling undertaken found that appropriate land raising in the rezoning area would result in only minor flood impacts and minor changes to flood risk.

2. Background

Council seeks to rezone a precinct of land at Gumly Gumly from RU1 Primary Production to B6 Enterprise Corridor. The precinct fronts both the north and south sides of the Sturt Highway and is adjacent to existing residential and commercial development (see Plate 1 over and also Figure 1). The precinct would be inundated during mainstream flooding of the Murrumbidgee River 1% AEP event and has been classified with varying degrees of provisional hydraulic hazard. Council is required to submit a Planning Proposal to the Department of Planning and Infrastructure. The proposal is required to meet the conditions set out under the S117 Directions for Flood Prone Land to assess the potential impact of the land rezoning.

water + environmental engineers

Webb, McKeown & Associates Pty Ltd (trading as WMAwater)

DIRECTORS

M K Babister
G L Hurrell
R W Dewar

BE(Hons), MEngSc GradDipMgt, FIEAust
BSc, BE(Hons), MIEAust
BSc(Hons), MEngSc, MAIG, MIEAust

ASSOCIATES

E J Askew
S D Gray
R Hardwick Jones

BE(Hons), MIEAust
BE, MEng

BE(Hons), MEngSc, MIEAust

ABN 50 366 075 980

Level 2, 160 Clarence St, SYDNEY NSW 2000
Phone: 02 9299 2855 Fax: 02 9262 6208
Email: enquiry@wmawater.com.au
Website: wmawater.com.au

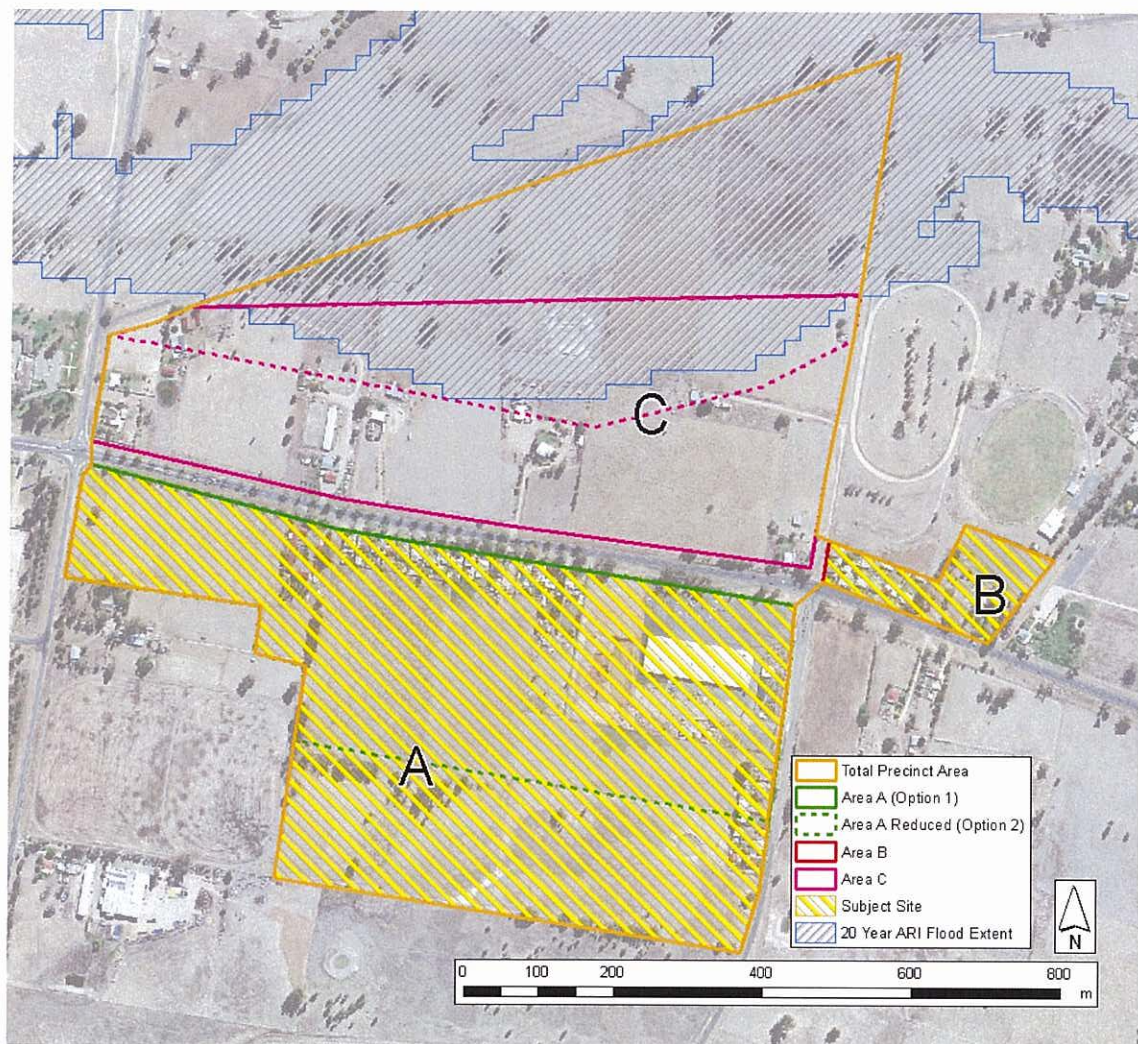


Plate 1: The Subject Site and Total Rezoning Precinct Area

Development controls are often used to stipulate minimum floor level requirements in order to reduce flood risk and consequences. However, where ground levels are low so that simple building raising would not be feasible due to issues over property access, suitable construction, building usability etc., then ground levels may need to be raised also. Ground level raising also assists in enforcing the appropriate floor level controls on future development. Such controls are applied to the adjacent Eastern Industrial Area, where a 5% AEP flood level plus 0.5m floor level control applies. As part of the proposed rezoning, the site would likely require land raising in order to achieve minimum floor levels for development.

Ground level raising is likely to have some impact on flood levels due to reducing available volume in the floodplain and altering the existing directions of flood flows. Therefore this Flood Impact Assessment has been prepared to investigate the potential impacts of land raising in the precinct and to assess whether these impacts are not unacceptable in terms of flood risk to the site itself and the surrounding area.

The precinct area consists of three sites on both sides of the highway. WMAwater have previously investigated the proposed rezoning (land raising) of the land within the precinct north of the Sturt Highway as part of Reference 1. The Flood Impact Assessment for the northern portion of the precinct found that rezoning, including land raising of some of the site, would not be unacceptable in terms of flood risk given the minimal flood level impacts and proximity to the East Wagga Wagga Industrial Area and associated flood risk.

Council now seeks to also rezone the land to the south of the Sturt Highway; the Subject Site. In accordance with Council's proposed B6 precinct mentioned above, Council has requested a study of the southern portion of the proposed precinct, so that a complete picture of the appropriateness of the precinct for the uses proposed, in terms of flood risk, can be obtained. The current study is required to assess the potential flood level impacts of rezoning, and subsequent land raising, of the portion of land to the south of the Sturt Highway and the smaller portion in the north of the highway in addition to the land north of this highway.

Figure 1 shows the precinct area for proposed rezoning. For the purposes of this Flood Impact Assessment the precinct has been sub-divided into three areas; A, B and C, each of which are likely to be raised above current ground levels to achieve appropriate floor level controls for flood risk management. The triangle of land north of site C is to be left at existing ground levels as per the conclusions of the previous Flood Impact Assessment for the northern precinct only (Reference 1) as filling within this flood runner area is likely to result in greater changes to flood behaviour. This portion of the precinct could be utilised for activities at ground level such as car parking or open space.

2.1. Existing Flood Situation

During a mainstream flood event the Murrumbidgee River first spills from the river meander to the east of the subject precinct. Out of bank flows then spread towards the precinct. Secondly the River spills near Brehour through a flood runner to the north of the precinct. The two flows combine to inundate the precinct.

The precinct is currently fully inundated by the 1% AEP flood event (100-year ARI) while the 5% AEP flood event (20-year ARI) affects part of the area to the north of Sturt Highway to depths of up to a maximum 0.7m. Existing flood depths in the 1% event are above 0.5m and can reach up to 2m in isolated areas (Figure 2). Modelled peak flood levels during the 1% AEP flood event generally reach 183.1 mAHD.

Provisional hydraulic hazard across the precinct under present conditions is a mix of high and low with the majority of the precinct south of the Sturt Highway classified as high hazard largely due to the flood depths at this location (Figure 3). The Sturt Highway between the north and south precinct is largely classified as low hazard as far as east Wagga Wagga Industrial Area although the surrounding area is high hazard.

2.2. Change of Use

Current land use in the precinct is RU1 Primary Production. It is proposed that the precinct is rezoned to B6 Enterprise Corridor. The allowable development in each zone is described below (as per Wagga Wagga LEP).

RU1 Primary Production

Permitted without consent:

Environmental protection works; Extensive agriculture; Home businesses; Home occupations; Roads

Permitted with consent:

Bed and breakfast accommodation; Cellar door premises; Dual occupancies; Dwelling houses; Extractive industries; Farm buildings; Farm stay accommodation; Hardware and building supplies; Home industries; Intensive livestock agriculture; Intensive plant agriculture; Markets; Open cut mining; Roadside stalls; Rural supplies; Rural workers' dwellings; Secondary dwellings; Timber yards; Any other development not specified in item 2 or 4

B6 Enterprise Corridor zone

Permitted without consent:

Roads

Permitted with consent:

Animal boarding or training establishments; Bulky good premises; Business premises; Community facilities; Depots; Garden Centres; Hardware and building supplies; Hotel or motel accommodation; Industrial retail outlets; Industrial training facilities; landscaping material supplies; Light industries; Liquid fuel depots; Passenger transport facilities; Plant nurseries; Recreation facilities (indoor); Rural supplies; Service stations; Signage; take away food and drink premises; Timber yards; Vehicle sales or hire premises; Vehicle repair stations; Veterinary hospitals; Warehouse or distribution centres; Wholesale supplies; Any other development not specified in item 2 or 4

Residential development is more vulnerable to flood risk than uses such as light industry or commerce. Flooding of residential properties can cause the loss of all belongings and pose significant risk to life. Furthermore through planning controls it is easier to impose requirements for flood plans and evacuations from commercial and industrial uses. In relation to these specific uses, floor level controls can also be used to reduce flood damages. Commercial and industrial properties can also be required to be flood proofed. The change of use will remove the possibility of development of further residential properties within the precinct. This can be seen as beneficial for the reasons stated above.

3. Methodology

3.1. Hydraulic Modelling

As mentioned previously, in order to rezone the precinct and allow for development, there is likely to be some fill on the site so that finished floor level requirements can be met and potential flood risk reduced. Hydraulic modelling is required to assess the impacts of topography changes within the floodplain.

The 2D hydraulic model established for Wagga Wagga City Council as part of the Murrumbidgee River Model Conversion Project 2010, was used for this study. This model was established using TULFOW, a widely used hydraulic modelling software package in Australia and internationally. Initially the existing model was re-established to create a base case for the site to represent current conditions. This became the scenario against which all flood level impacts were calculated.

Having established the base case, two model scenarios representing land raising options were assessed.

3.2. Development Area Options

A previous Flood Impact Assessment was undertaken for the full precinct area north of the Sturt Highway. It initially looked at the option of filling the whole area north of the highway, but found that raising land in the flood runner would result in significant impacts and high hazard in potential development areas. Due to significant impacts caused by raising the whole area north of the highway, the raised area was reduced to "Option B". Under Option B, the northern most portion of the precinct which becomes a flood runner under 5% AEP flood event conditions was left at existing ground levels so as not to obstruct or impact on flows through the north of the site. Land not affected by the 5% AEP flood event was raised 300 mm above ground levels while land within the periphery of the 5% AEP flood extents was raised to 0.5m above the 5% AEP event flood level (approximately 182.1mAHD) as a minimum. The raised ground levels were tied into the existing ground levels in the flood runner to the north, and the ground levels raised 300 mm above exiting to the south. The reduced site (Option B) aligns better with the area subject to low provisional hydraulic hazard under existing conditions and maximises the use of the low provisional hydraulic hazard land while minimising flood impacts on the high provisional hydraulic hazard areas through the north of the precinct and the surrounding area.

To appropriately assess the cumulative impacts of land raising in the north precinct (Area C) with the combined land raising in the south precinct (Areas A and B) the "Option B" reduced area is also considered in this Flood Impact Assessment. The area north of the Sturt Highway is shown in Figure 1 and named as area C in this Flood Impact Assessment.

Two options were considered:

Area	Option 1	Option 2
A	Raised 0.3 m above ground levels for approx. 480 m south of Sturt Highway	Raised 0.3 m above ground levels for approx. 300 m south of Sturt Highway
B	Raised 0.3 m above ground level	
C	Area within 5% AEP flood extent raised to 5% AEP flood level plus 0.5 m. Area north of highway and outside the 5% AEP flood extents raised 0.3 m above ground level. (as modelled as Option B in the previous Flood Impact Assessment)	

Area B is not flood affected in the 5% AEP event so was raised 0.3 m above ground levels. Likewise area A was also raised 0.3 m above ground levels. The two options considered different extents of Area A; Option 1 raising land to a distance of approximately 480 m from the Highway (the entire land parcel to the south) and Option 2 raising land a distance of approximately 300 m south of the highway (Figure 1).

For Option 2, the reduced area of raised land south of the Sturt Highway was refined based on a review of model results from the existing scenario and Option 1. Option 2 reduces the area of raised land in Area B. The area removed is at the south of the land parcel where model results showed flood depths to be in excess of 1 m and hydraulic hazard to be high under the both existing and Option 1 scenarios.

4. Development Impacts for 1% AEP event

Each of the options was considered in terms of impacts on flood levels as well as provisional hydraulic hazard for the 1% AEP event (100-year ARI event). A series of figures attached to this letter report show the impacts of each of the options. Provisional hydraulic hazard is assigned based on a value determined from the product of depth and velocity and gives no other consideration to other factors that contribute to flood risk.

4.1. Option 1

Impacts from Option 1 are shown in Figure 4. The greatest impact occurs at the east boundary of Area A where ground, if raised as per Option 1, would reduce the width of the existing flow path south of the Sturt Highway. This causes increases in flood levels of up to 0.06 m. This is a localised impact and generally impacts are not higher than 0.05 m.

Flood depths on the raised area are generally less than 0.8 m apart from the southernmost portion of Area A where flood depths reach up to 1.4 m (Figure 6). In this location provisional hydraulic hazard is also classed as high (Figure 8) due to the flood depths occurring.

4.2. Option 2

Option 2 reduces the raised area in Area A south of the Sturt Highway to a lesser extent chosen following a review of the flood depths and flood hazard in this location. The raised area removed from Area B was subject to high hazard and flood depths of over 1 m in Option 1. Land within Area B which was generally only low hydraulic hazard and subject to flooding to depths less than 1 m in the Option 1 scenario was included in the raised area for Option 2.

Impacts of Option 2 are shown in Figure 5. Although the impact extent is much the same as Option 1, the increases in flood levels are less, particularly to the east of Area A. All off site impact is less than 0.05 m. Impacts over the East Wagga Wagga Industrial Area are a maximum of 0.025 m and therefore considered to be negligible.

Flood depths on the raised areas of the precinct are generally less than 0.8 m. In area C the northern portion of the site is flooded to depth of up to 0.8 m although the south of the site fronting the Sturt Highway is flooded up to a maximum of 0.6 m. Area A is generally only flooded to a depth of less than 0.8 m. On Area B, part of the site actually becomes no longer flooded in the 1% AEP event with maximum flood depths on the flooded portion of the site up to 0.3 m.

All the raised areas generally become low hazard due to the reduced flood depths and velocities over the raised land (Figure 9).

5. Flood Risk Management Guidance

During the 1% AEP event peak flood levels fronting the site on Sturt Highway are approximately 183.1 mAHD. Available warning time is in excess of two days however, the site could become inaccessible for more than two days following inundation although it should be noted that times will vary depending on the duration of the event. The available flood warning time is considered suitable for the implementation of a Flood Plan allowing strategies to have the potential to significantly reduce damages to property and allow for evacuation of people from the site if undertaken properly.

The areas surrounding the site are generally identified as high hazard with the exception of the industrial area of East Wagga Wagga.

Option 2 would be the most appropriate for adoption in terms of flood risk considering the hazard classification of proposed development areas and the impacts from any land raising. Currently the precinct contains some residential dwellings. Rezoning the precinct as a commercial or industrial use will mean that over time residential dwellings will be removed from the area. It is considered that a commercial or industrial development is less vulnerable to flood risk compared to residential development. Commercial and industrial development is more likely to have flood evacuation plans and is not likely to have people sleeping overnight on the premises.

The previous Flood Impact Assessment for the northern precinct suggested that in the high hazard portion of the site (the area in the 5% AEP flood runner that has not been raised) it is not recommended to allow development of buildings where concentrations of people, stock and machinery may be present. Instead, in this area, development should be compatible with the high level of flood hazard and the flood depths likely to occur and therefore a lower risk usage such as car parking. Car parking at existing ground levels would not result in any adverse flood level impacts and given the length of warning time available it would be likely that evacuation of vehicles can take place prior to peak flood levels occurring. Should anything be stored in this area it should be removed before the onset of flooding so as not to obstruct flood flows and also as a measure to avoid increased flood risk by large floating debris picked up in the flood runner. These recommendations can also be applied to the southern portion of Area A which is not raised above existing levels.

For the rest of the precinct classified as low hazard suitable flood planning controls can be used to set minimum floor levels and flood proofing height.

Although raising the areas of land will reduce the flood depths on the site, it will not entirely eliminate flood risk and flood depths of up to 1m could still occur on site in the 1% AEP event. Suitable floor level controls should be used to reduce flood risk. Councils often define a flood planning level of 0.5 m above the 1% AEP flood level and stipulate that finished floor levels should be set at this level. However, in this area it would mean the floor levels are required to be between approximately 183.5 mAHD and 183.2 mAHD and in some areas of the site over 0.9 m above ground levels. As an alternative option where floor levels at such a height above ground levels is not feasible, flood proofing of a building to the flood planning level (ie the 1% AEP flood level plus 0.5 m) would be recommended. In all instances of development within the floodplain it is recommended that floor levels are built above ground to some degree. This can be used in conjunction with raised floor levels and is only appropriate for development which is less vulnerable to flood risk.

Planning controls can also be used to ensure that any development in a flood prone area has suitable flood evacuation and contingency plans in place. As a condition of a development approval, properties would need a comprehensive flood evacuation plan including details on evacuation of people and vehicle as well as consideration with regards to moving stock and machinery if necessary.

B6 land use allows for hotel or motel accommodation to be permitted with consent. This is potentially a higher risk land use due to the numbers of itinerant people using the building. It is recommended that stricter controls such as floor levels and flood proofing are placed on higher risk development, or that this use is not allowed within the newly rezoned precinct. Likewise, liquid fuel depots, can be high risk development in flood prone areas and additional controls such as flood proofing or consideration to storage of fuels above the flood levels may be appropriate.

The proposed rezoning, and subsequent land raising does have impacts in terms of flood levels but these can be considered minor. Rezoning would also reduce the vulnerability of the type of development in the precinct by replacing residential properties with new commercial industrial properties as well as allowing for development controls on new development to reduce flood risk. Option 2 is therefore considered appropriate in terms of flood risk.

6. Conclusions and Recommendations

The following conclusions and recommendations are drawn from the study:

1. Flood impacts have been assessed for the 1% AEP flood event for two potential land raising options within the precinct. Earthworks undertaken which raise additional areas or do not raise land to the levels modelled in this hydraulic modelling assessment will likely result in different impacts to those described and discussed in this study.
2. Land raising would be required to enable appropriate floor levels to reduce flood risk for any development in the newly rezoned area.
3. Land raising will have flood level and hydraulic hazard impacts. The hydraulically modelled Option 2 is considered to have minimal impacts and not be unacceptable in terms of flood risk.
4. Option 2 involves raising a portion of the southern precinct 300 mm above ground levels for approximately 300 m south of the Sturt Highway (Area A) as well as a small area of land north of the highway (Area B). This is considered in addition to the Option B already found to be appropriate in the January 2012 Flood Impacts Assessment (Reference 1) as it is assumed both portions of land would be raised as part rezoning.
5. Development controls should include requirements for setting finished floor levels and flood proofing of buildings.
6. Development controls should be used to ensure flood evacuation and contingency plans for all development in the precinct.
7. On the portion of Area B not raised appropriate development controls are recommended to limit development to low risk uses such as car parking which can be readily evacuated and those uses where significant flood depths would not cause substantial damage.

Yours Sincerely,

WMAwater



Erin Askew

Associate

Enc.

- Figure 1: Location Plan
- Figure 2: Existing 1% AEP Depth and Flood Level Contours
- Figure 3: Existing 1% AEP Flood Hazard
- Figure 4: Option 1 – Impacts
- Figure 5: Option 2 – Impacts
- Figure 6: Option 1 – Flood Depths
- Figure 7: Option 2 – Flood Depths
- Figure 8: Option 1 – Provisional Hydraulic Hazard
- Figure 9: Option 2 – Provisional Hydraulic Hazard
- Figure 10: Option 2 – Developable Ground Level Contours

References

- Reference 1 - WMAwater, January 2012, Flood Impacts Assessment Proposed Rezoning of Rural Land at Gumly Gumly, for J Howard and R Allsop