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MIFSUD REZONING & INDUSTRIAL DEVELOPMENT, LAKE CATHIE

Flood Impact Assessment

rp7551arm_crt090730-Mifsud Lake Cathie FIA.doc

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Water Resources

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Project: 7551 - MIFSUD REZONING & INDUSTRIAL DEVELOPMENT, LAKE CATHIE

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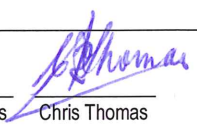
B	Final	AM Andrew Morris	CRT Chris Thomas	 Chris Thomas	10/9/10	N/A	

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1. INTRODUCTION

Mifsud Industrial Pty Ltd (*Mifsud*) plans to develop a parcel of land that is referred to as Lot 10 DP 615775 Ocean Drive, Lake Cathie. As shown in **Figure 1**, the land is located along the western frontage of Ocean Drive and extends south from its intersection with Houston-Mitchell Drive. It is currently zoned 1(a1) *Rural* under the Hastings Local Environmental Plan (2001).

The site is located near the downstream end of a 252 ha catchment that drains to an undeveloped area on the eastern side of Ocean Drive. The extent of the catchment and the location of the site within it is shown in **Figure 2**.

The western boundary of the site adjoins dense bushland. The area to the east of the site has been cleared for grazing and drains to a series of constructed wetlands that are situated along the northern limit of the urban precinct of Bonny Hills.

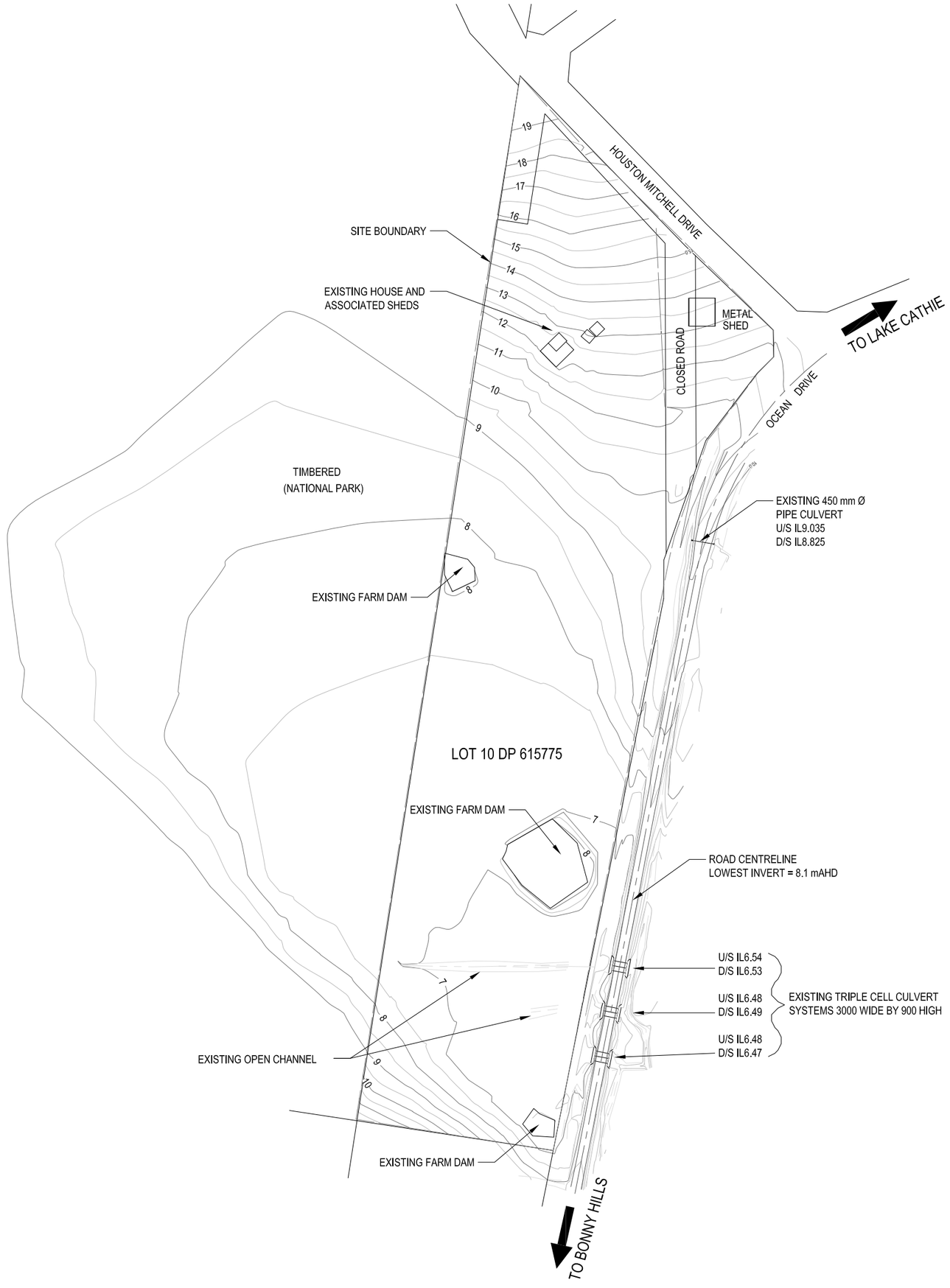
As shown in **Figure 1**, an ephemeral stream that drains the catchment traverses through the Mifsud Site. The Ocean Drive roadway embankment (*refer* **Figure 1**) presents as a barrier to the easterly discharge of floodwaters, but incorporates three triple cell culvert systems that concentrate runoff and discharge it to the east of the site. The locations of the three culvert systems are highlighted in **Figure 1**.

Notwithstanding, there is potential for floodwaters to pond in the area upstream from the roadway embankment leading to inundation of a large proportion of the Mifsud Site.

Accordingly, King and Campbell Pty Ltd, acting on behalf of Mifsud, engaged WorleyParsons to undertake flood investigations aimed at determining the 100 year recurrence flood level at the site. The results of these investigations are discussed in a draft Site Flood Assessment Report that was issued to King & Campbell in January 2009. The Site Flood Assessment Report established that the peak 100 year recurrence flood level at the site is estimated to be 7.6 mAHD. The findings of the Site Flood Assessment Report have been included in this document.

Following submission of the Site Flood Assessment Report, King & Campbell provided WorleyParsons with a plan showing the layout for the proposed development of the site. The plan included a lot layout and an indicative extent of proposed fill. The fill is required to raise the level of the terrain where development is being proposed and is necessary in order for the land to be rezoned for industrial development.

FIGURE 1



LEGEND

IL 6.54	INVERT LEVEL OF CULVERT IN METERS RELATIVE TO AHD
10	ELEVATION OF NATURAL SURFACE IN METERS RELATIVE TO AHD

NOTES

1. CONTOUR INTERVAL = 0.5m
2. ALL DIMENSIONS ARE IN mm
3. SURFACE ELEVATIONS SHOWN RELATIVE TO METRES ABOVE AHD
4. ORIGIN OF LEVELS -
   PM 71722
   RL 19.163 AHD
5. SURVEY COORDINATED TO SSM16940
6. SOURCE DRAWING REFER KING & CAMPBELL DRAWING No. - 14661S_DET3D_DETAIL SURVEY FOR FLOOD IMPACT STUDY

0 30 60 90 120 150m

1 : 1500

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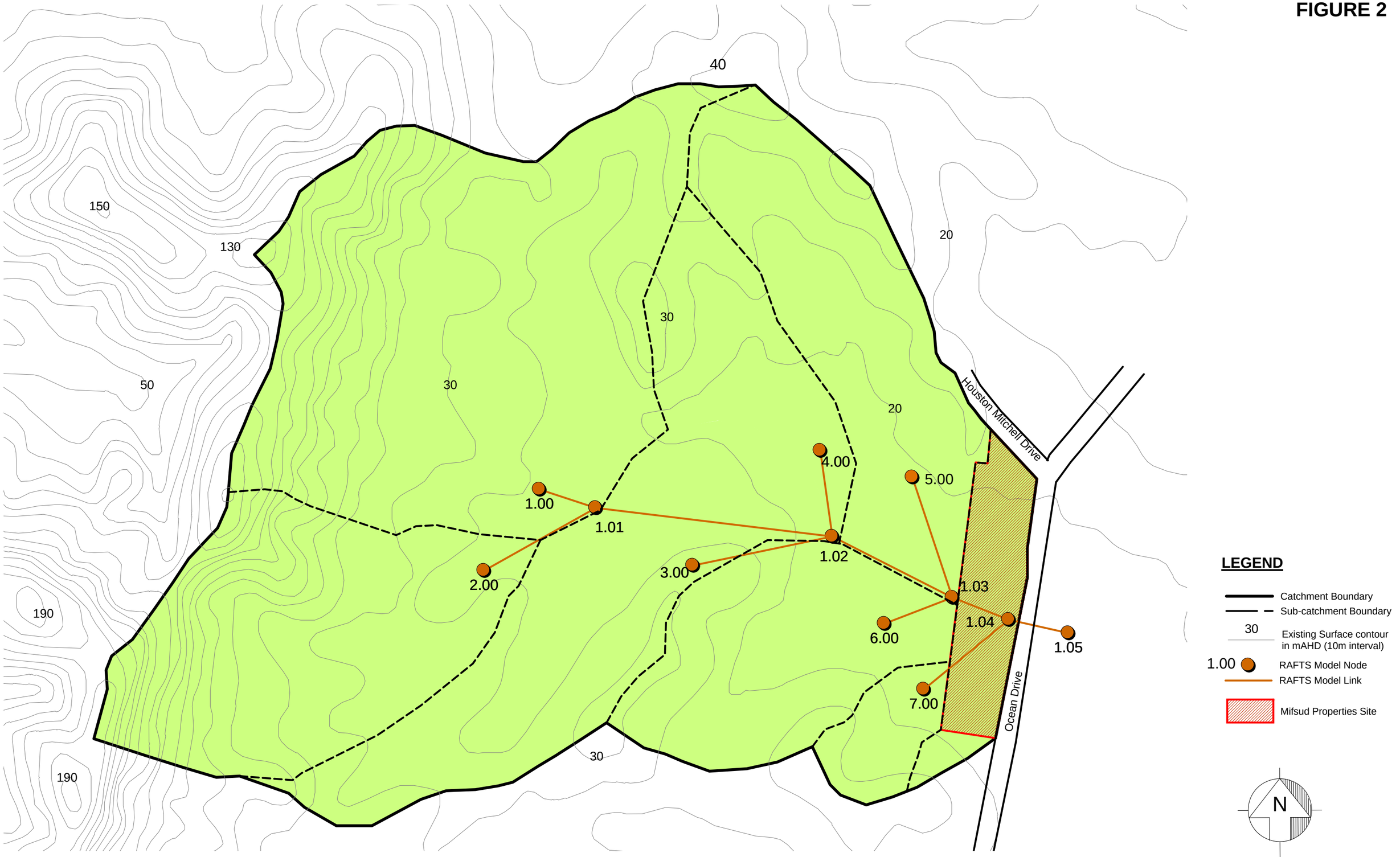
Mifsud Properties FIA
fg7551nd081212- SITE PLAN.DWG

LOCATION AND EXTENT OF SITE PROPOSED FOR REZONING

FIGURE 2



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Mifsud Properties FIA
fg7551nd120109-Fig2-Rafts Network.wor

NODE AND LINK ARRANGEMENT FOR RAFTS HYDROLOGIC MODEL

However, the proposed filling has the potential to reduce the available flood storage and could lead to an increase in peak 100 year recurrence flood levels upstream from the site. This could also increase the peak flood discharge through the culvert system located underneath Ocean Drive, potentially creating adverse conditions for properties located downstream. In addition, the development will result in an increase in stormwater run-off and has the potential to increase the peak of the hydrograph entering the flood storage area.

This report documents the results of investigations that have been undertaken to characterise existing flood conditions at the site. It also documents the magnitude and extent of the impact that the proposed filling of the land may have on existing flood characteristics.

2. SITE FLOOD ASSESSMENT

2.1 HYDROLOGIC ANALYSIS

The catchment draining to the Mifsud Site extends 2 kilometres to the west of Ocean Drive and rises to an elevation of 190 mAHD. It has an area upstream of Ocean Drive of 252 ha. Almost all of this area is densely vegetated.

In order to determine peak flood flows that could potentially be discharged to the site, a hydrologic model of the catchment was developed. The hydrologic model was developed using the Runoff Analysis and Flow Training Simulation (*RAFTS-XP*) software package.

RAFTS-XP is a deterministic runoff routing model that simulates catchment runoff processes. It is recognised in *'Australian Rainfall and Runoff – A Guideline to Flood Estimation'* (*ARR 1998*), as one of the available tools for use in flood routing within Australian catchments. The layout of the RAFTS model is shown superimposed over a plan of the catchment as shown in **Figure 2**.

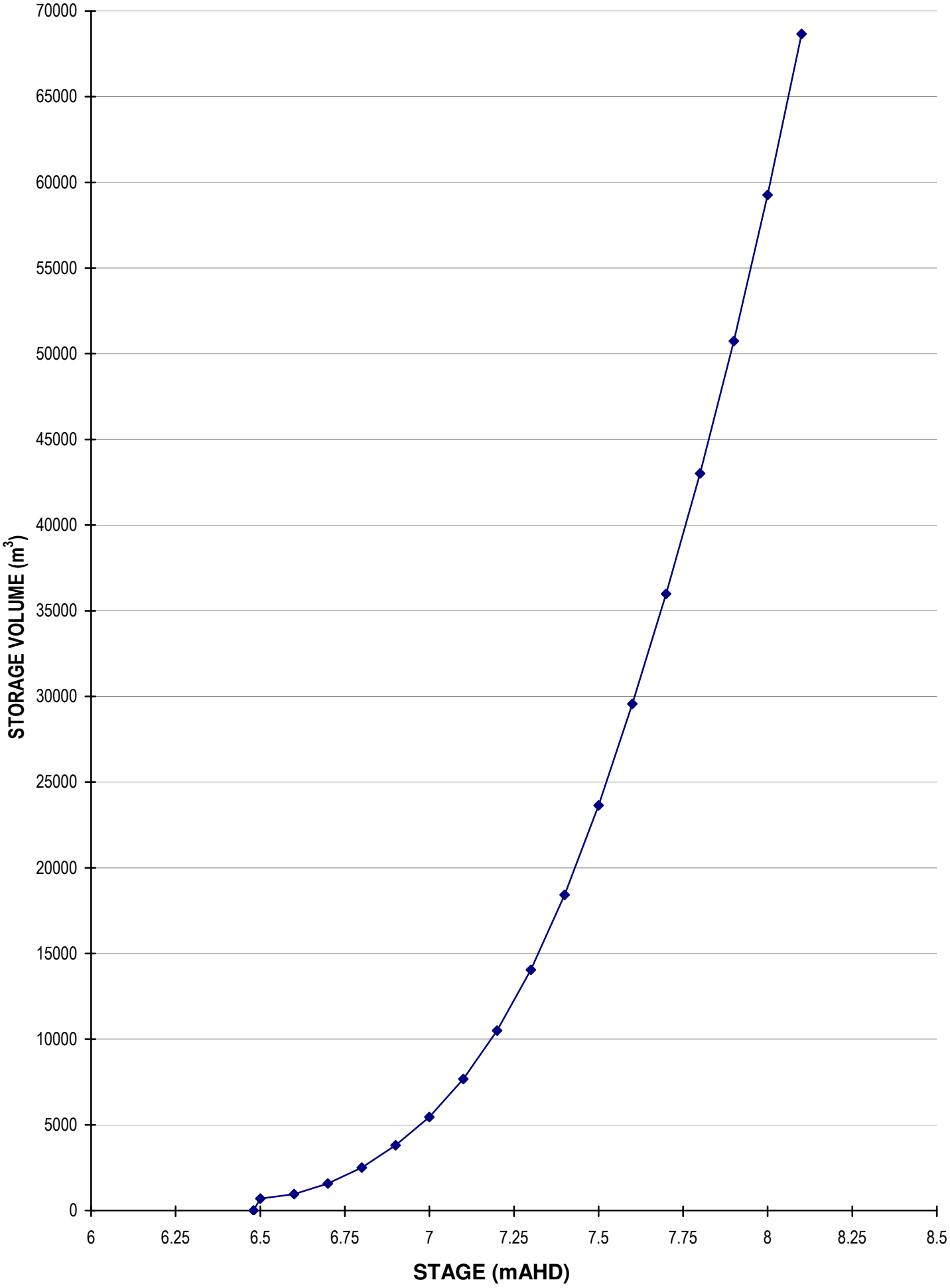
As shown in **Figure 2**, the upper catchment was subdivided according to drainage lines interpreted from available aerial photography and topographic mapping. Catchment subdivision also considered the homogeneity of existing land use and vegetation cover. Subcatchment characteristics such as area, slope, percentage imperviousness and roughness, were extracted from the mapping and incorporated within the model data-set.

As outlined in **Section 1**, the Ocean Drive roadway embankment effectively "blocks" the free discharge of overland flows and in conjunction with the culvert system, acts as a hydraulic control. As a result, areas of the Mifsud Site upstream from the culverts act as a flood storage area in a similar manner to a detention basin.

Accordingly, the RAFTS model was developed to incorporate the storage afforded by these areas and created by the roadway embankment. The storage was quantified by analysis of the topographic data shown in **Figure 1**, which resulted in determination of the stage-storage relationship presented in **Figure 3**.

In addition, hydraulic analyses were undertaken to determine the flow that would be discharged through the culvert system at different levels of storage. This resulted in development of the stage-discharge relationship shown in **Figure 4**.

FIGURE 3



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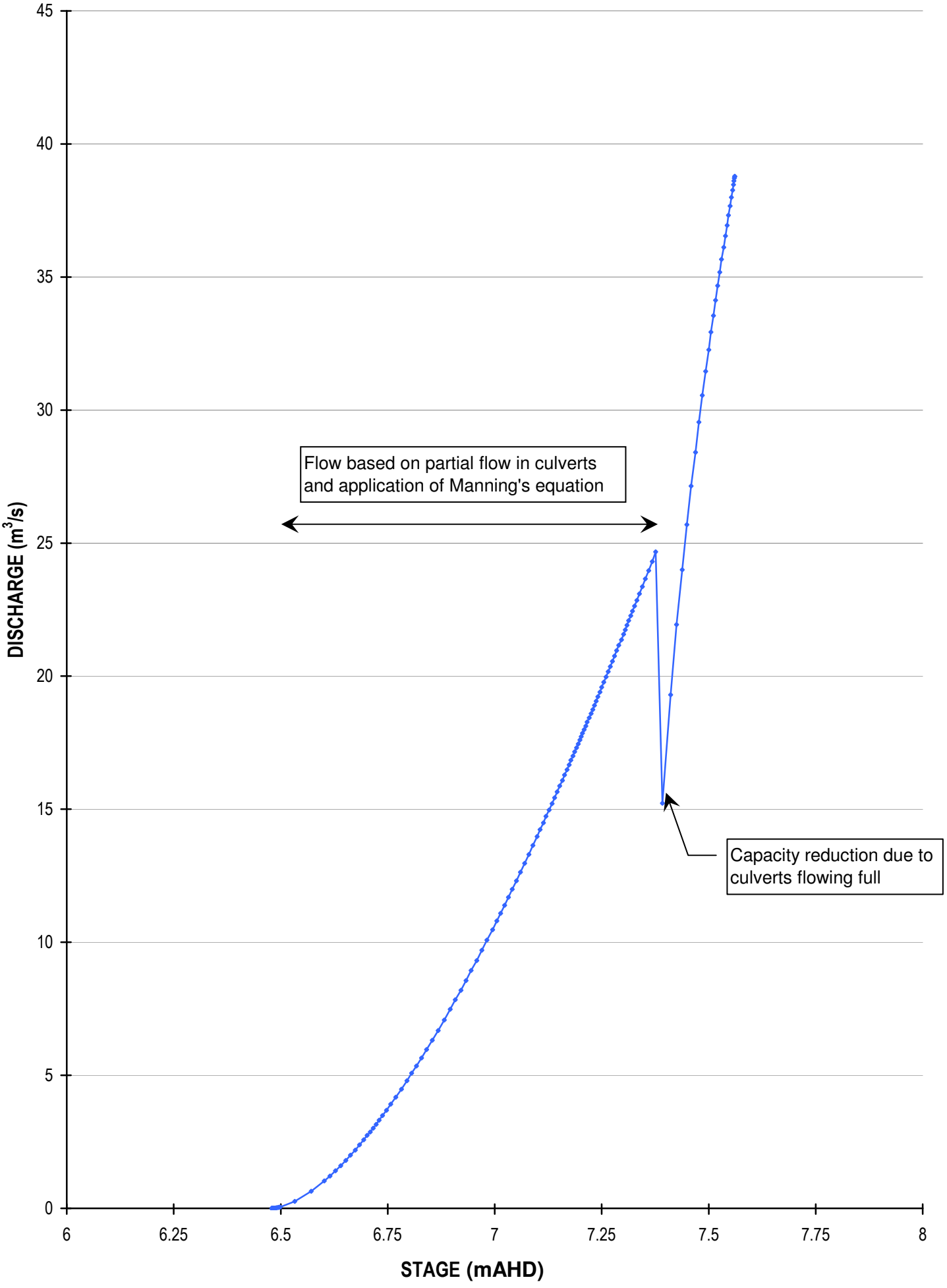
Mifsud Industrial FIA
fg7551nd080312- Fig 3 - Stage Storage

STAGE-STORAGE RELATIONSHIP FOR MIFSUD INDUSTRIAL SITE

FIGURE 4



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Mifsud Industrial FIA
fg7551am090710-Fig4 - Stage Discharge Relationship.xls

STAGE-DISCHARGE RELATIONSHIP FOR MIFSUD INDUSTRIAL SITE

The stage-discharge relationship indicates that a sharp reduction in the discharge capacity occurs as the upstream water level reaches the obvert of culverts within the three culvert systems. At this point, the culvert is predicted to be "drowned out". The increase in friction causes a reduction in discharge capacity. The relatively large reduction is due to the number of culverts and the relatively large ratio of width to depth.

The RAFTS model was used to simulate the design 100 year recurrence storm event for the full range of standard storm durations defined in ARR 1998. The results of the analysis were interrogated to determine the critical storm duration for the catchment draining to Ocean Drive.

The 270 minute storm was identified as the critical storm duration for the design 100 year recurrence event. This event generated a peak flow of 41 m^3/s at the western boundary of the site. The simulation also showed that the storage afforded by the roadway embankment and culvert system led to a 5% attenuation of the peak flow. The 100 year recurrence flood discharge at the downstream side of Ocean Drive is estimated to be 38.8 m^3/s.

2.2 PREDICTED PEAK FLOOD LEVEL

The results of the design flood simulations for existing conditions indicate that under a "no-blockage scenario", the 100 year recurrence flood is predicted to reach an elevation of 7.6 mAHD. This is about 500 mm below the minimum crest level of the section of Ocean Drive that fronts the eastern side of the site. Accordingly, all runoff from the upstream catchment must be discharged via the three culvert systems shown in **Figure 1**.

In order to determine the sensitivity of peak flood levels to culvert blockage, a simulation was undertaken assuming 35% blockage of all three culvert systems. This assumption was based on typical blockage scenarios adopted by local government in NSW. In that regard, it is noted that Port Macquarie-Hastings Council's stormwater design guidelines do not require a blockage scenario to be considered.

The blockage factor was applied by reducing the culvert width by 35% in order to simulate the maximum impact on culvert performance through the range of storage elevations.

In this regard, it should be noted that the application of a blockage factor of this magnitude to all three culvert systems simultaneously is considered to be extremely conservative. It is highly unlikely that the blockage of culverts that are 30 metres apart would occur simultaneously.

Notwithstanding, application of the 35% blockage factor across all culverts only resulted in a 0.2 metre increase in peak 100 year recurrence flood level; that is, an increase from 7.6 mAHD to 7.8 mAHD. The associated increase in flood extent is shown in **Figure 5**.

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Mifsud Properties FIA
fg7551nd081212-100yr ARI extent.doc

PREDICTED 100 YEAR ARI FLOOD EXTENT FOR EXISTING CONDITIONS

3. FLOOD IMPACT ASSESSMENT

3.1 DESCRIPTION OF PROPOSED DEVELOPMENT

The proposed development involves the subdivision of the Mifsud Site into sixteen separate allotments. The lots are arranged around a centrally located road which joins Houston Mitchell Drive. The proposed layout is shown in **Figure 6**.

Guidelines for determining minimum floor levels for development are contained in the Port Macquarie Hastings Council (PMHC) Interim Local Government Area (LGA) Flood Policy. The Policy was adopted by Council in April 2007 and states that the flood planning level for commercial and industrial development is defined by the peak level of the 100 year recurrence flood. In addition, at least 25% of the floor area of any commercial/industrial development must be located a specified distance above the peak 100year ARI flood level. For areas east of the Pacific Highway, this distance or "freeboard" is 800 mm.

The existing site contour information indicates that all of Lots 7 and 8 and sections of Lots 6 and 9 are located on land that is below the predicted100 year recurrence flood level. Therefore, filling of these lots, up to the peak 100 year ARI flood level of 7.6 mAHD is proposed in order to meet the requirements of Council's Flood Policy. The same sites will require extra filling to meet the additional freeboard requirements outlined above.

In addition, some filling of Lot 10 and possibly Lot 11 and 5 will also be necessary. While alternative methods could be employed to meet the freeboard requirements, it has been assumed that filling would be undertaken to facilitate slab on ground construction for future development on the site. This is considered to provide the worst possible conditions in terms of floodplain encroachment. The approximate location of the 8.4 metre AHD contour effectively defines the extent of the lots that would need to be filled if the additional freeboard requirement applied to the entire area of each lot.

The fill requirements discussed above are estimated to lead to a reduction in the storage volume of 5,600 m^3 up to the existing 100 year ARI peak flood level at the site. The modified stage storage relationship, including a comparison against the existing stage storage relationship is included in **Figure 7**.

3.2 PROPOSED DEVELOPMENT FLOOD MODELLING SCENARIOS

Two scenarios were modelled to determine the potential impact of the proposed development on the predicted 100 year recurrence flood level at the site.

FIGURE 6

LEGEND

IL 6.54	INVERT LEVEL OF CULVERT IN METERS RELATIVE TO AHD
10	ELEVATION OF NATURAL SURFACE IN METERS RELATIVE TO AHD
12	DENOTES LOT NUMBERS

NOTES

1. CONTOUR INTERVAL = 0.5m
2. ALL DIMENSIONS ARE IN mm
3. SURFACE ELEVATIONS SHOWN RELATIVE TO METRES ABOVE AHD
4. ORIGIN OF LEVELS -
   PM 71722
   RL 19.163 AHD
5. SURVEY COORDINATED TO SSM16940
6. SOURCE DRAWING REFER KING & CAMPBELL DRAWING No. 14661P_LAYOUT_PROPOSED SUBDIVISION LAYOUT

0 30 60 90 120 150m

1 : 1500

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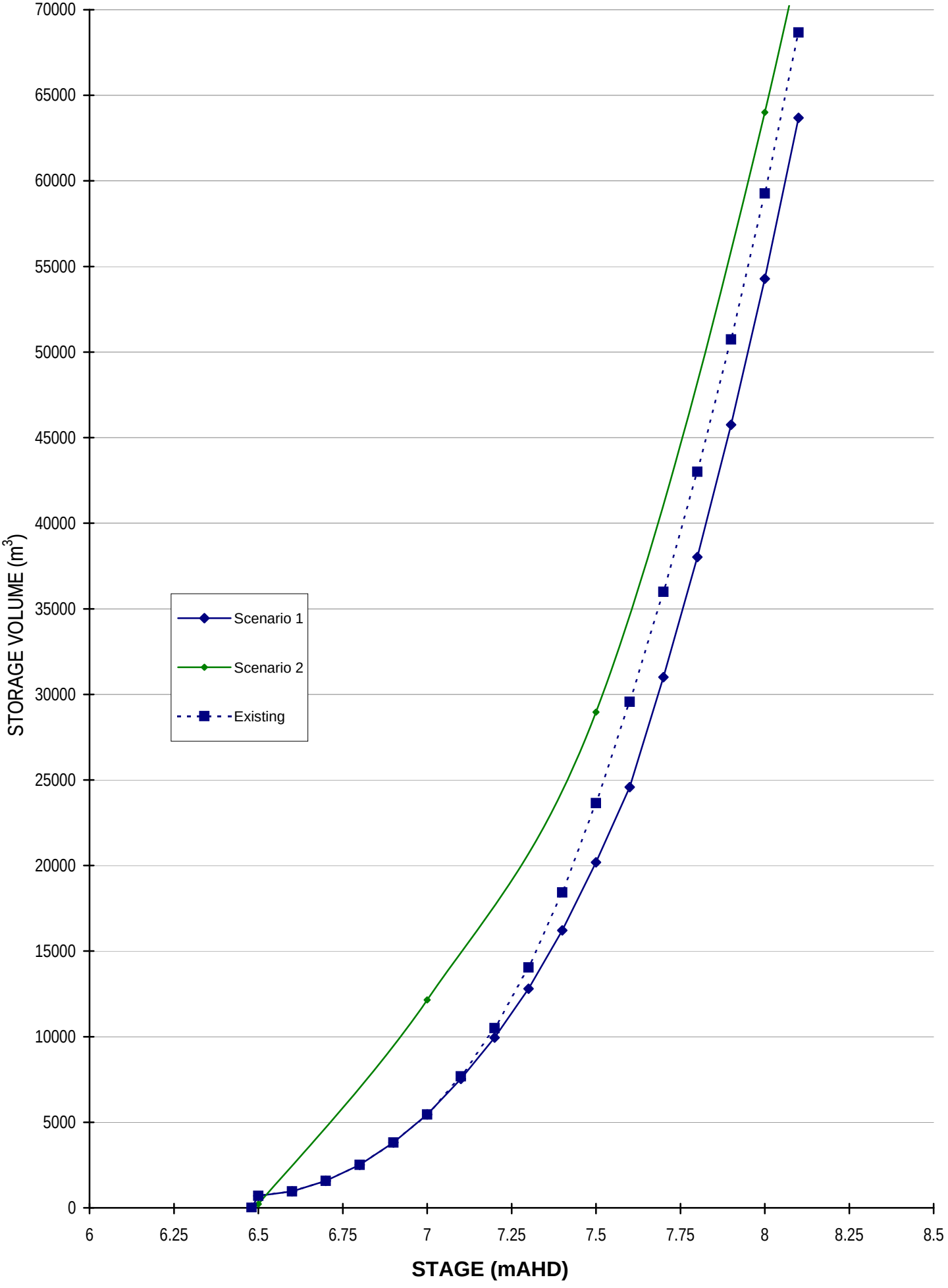
Mlfsud Properties FIA
fg7551nd081212- Site Plan.dwg

PROPOSED LOT LAYOUT AND EXTENT OF FILLING

FIGURE 7



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Mifsud Industrial FIA
fg7551nd080312- Fig 7 - Propose Stage Storage Relationship.xls

STAGE-STORAGE RELATIONSHIP FOR POST DEVELOPMENT SCENARIOS

Scenario 1 involves simulation of flooding for the proposed development layout as described above. The existing hydrologic model was modified to incorporate the stage-storage relationship shown in **Figure 7** and run-off parameters for the development site were modified to reflect a post development scenario (ie. greater imperviousness).

Scenario 2 involves simulation of flooding based on the proposed development layout but with the area south of the proposed fill platform excavated to 6.5 mAHD. This is equivalent to the invert level of the existing culverts. The extent of the proposed excavation area is shown on **Figure 6**. The additional storage volume that would be achieved by undertaking this additional excavation is estimated to be 9, 200 m^3.

Modifications to run-off parameters for the development site are included in the hydrologic models that were developed for both scenarios. The proposed development has the effect of reducing permeability in the area as a result of the construction of roads and buildings.

3.3 FLOOD MODELLING RESULTS

Design flood simulations were completed for the two scenarios to determine the impact on the peak 100 year recurrence flood level at the site and associated flood characteristics. The results of the simulations are discussed in the following.

Scenario 1

The results of the design flood simulations for the proposed site conditions associated with Scenario 1 indicate that the peak of the 100 year recurrence flood is predicted remain unchanged at an elevation of 7.6 mAHD. A minor increase in peak flood level is predicted, but it is much less than 0.1 metres and therefore makes no change to the reported flood level. It is considered to be less than the margin of error generally associated with flood modelling.

The associated peak 100 year ARI discharge through the culvert system is estimated to be 39.5 m^3/s, which represents an increase in the peak discharge of 0.7 m^3/s.

Scenario 2

Inclusion of the additional storage volume that would be achieved by excavation to 6.5 mAHD results in no measurable increase in the peak 100 year ARI flood level at the site. The model predicts the peak flood level will remain at 7.6 mAHD and the peak discharge through the culvert system will remain at 38.8 m^3/s.

3.4 DISCUSSION OF RESULTS

The negligible difference in peak flood level can be attributed to the large discharge capacity of the culvert system the drains the site. The culverts have sufficient capacity to carry the peak 100 year ARI flow without causing substantial backwater flooding. Although the storage capacity is reduced in Scenario 1, there is little attenuation of the inflow hydrograph. The modified stage-storage condition leads to only minimal impacts on peak flood level.

The minor increase in the peak discharge through the culvert system is not considered to be an issue. It is not anticipated to cause any measurable increase in peak flood levels on the downstream side of Ocean Drive.

The increase in run-off resulting from the proposed development also makes no difference to the overall inflow hydrograph. In this case, the peak flow from the local catchment does not coincide with the peak of the hydrograph entering the flood storage area from the upstream catchment. This is due to the close proximity of the development area to the culvert outlet, relative to the rest of the catchment.

The results indicate that the provision of additional cut to offset the proposed filling is unnecessary. The additional fill that is required for the proposed development to proceed and the associated loss of flood storage will not lead to any adverse impacts on adjoining properties.

4. CONCLUSIONS

Hydrologic modelling for the catchment draining to Ocean Drive indicates that the peak 100 year recurrence flood level at the Mifsud Site for existing conditions is estimated to be 7.6 mAHD. This will result in 44% of the site being inundated at the peak of the flood under existing conditions.

As part of a proposal to rezone and develop the site it is proposed that a section of the site be filled as shown in **Figure 6**. The fill is required to allow development to proceed in accordance with Council's Interim Flood Policy.

Design flood simulations were completed for the proposed site layout to assess potential adverse impacts on the peak 100 year recurrence flood level. The potential impact on peak discharge through the existing culvert system underneath Ocean Drive was also considered.

The results of the modelling indicate that filling for the proposed development will have minimal impact on the peak 100 year ARI flood level. The peak 100 year ARI flood level at the site is predicted to increase by 10mm due to the filling and will lead to no increase in the reported 100 year ARI flood level for the site. A minor increase in the peak flood discharge through the culvert system is predicted to occur. However, this increase is less than 2% of the pre-development flow and is not considered to present any concerns for the site located downstream.

5. REFERENCES

- Port Macquarie - Hastings Council (*2007*), *'Interim Port Macquarie-Hastings LGA Flood Policy'*
- Willing & Partners Pty Ltd (*1996*), *'RAFTS-XP User Manual'*.
- Institution of Engineers (*1987 and 1998*), *'Australian Rainfall and Runoff – A Guide to Flood Estimation'*; edited by DH Pilgrim.
- Port Macquarie - Hastings Council (*2001*), *'Hastings Local Environment Plan (2001)'*