Appendix M

Flooding, Coastal Processes and Climate Change Report

Coastal Issues, Flooding & Climate Change Report

Seniors Living Proposal
Main Rd, Toukley

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introduction

A SEPP Seniors Living development is proposed on foreshore site at Toukley.

The proposal is to be assessed under part 3A of the EPA Act 1979. The DGRs for the project require that the following matters be addressed:

> *Address coastal hazard and the provisions of the Coastline Management Manual. In particular consider impacts associated with wave and wind action, coastal erosion, climate change, sea level rise and more frequent and intense storms.*
>
> *Provide an assessment of any flood risks on the site, taking into consideration any relevant Council requirements and the NSW Floodplain Development Manual (2005). This should include: determining flood hazard, the impact of flooding on the proposed development, the impact of the development on existing flood behaviour and the impact of flooding on the safety of people/users of the development.*
>
> *A risk management assessment of climate change impacts to the year 2100, is to be undertaken using the latest available information from the International Panel on Climate Change (IPCC), Department of Environment and Climate Change (DECC) and the CSIRO. This should include sensitivity analyses for low level, mid range and high level ocean impacts as set out in relevant DECC Guideline (Floodplain Risk Management Guideline: Practical Consideration of Climate Change, 2007).*

The site adjoins Lake Budgewoi. The lake is part of the Tuggerah Lakes system in Wyong Shire on the NSW Central Coast, refer to Figure 1.

As a foreshore site the development faces potential threats from coastal processes, flooding and sea level rises through climate change.

Figure 1 Location plan (source Google Earth)

Appropriate site management is required to ensure the development does not adversely affect the adjoining estuary.

The site does not extend to the lake foreshore. There is a parcel of Crown Land approximately 6 metres wide between the northern boundary of the site and Lake Budgewoi.

ADWJohnson has been engaged by Rustrum Pty Ltd to respond to the sections of the DGRs as quoted above as a report to be included in the Environmental Assessment for the seniors living project.

1.0 the site

1.1 LOCATION

The development site is close to Lake Budgewoi which is an estuary and is part of the Tuggerah lakes system.

Figure 2 Site location

Between the development site and the lake is a strip of foreshore Crown land approximately 6 metres wide. This foreshore area has been significantly modified. The foreshore area has been managed as part of the adjoining properties which is consistent with local foreshore areas generally. Natural vegetation has been largely replaced by lawns. Low seawalls and retaining walls have been built on most property frontages in the area. There is no public access along the foreshore.

The current water level of Lake Budgewoi is approximately zero metres AHD with a tidal range generally less than 10 cm. The Tuggerah lakes are shallow having an average depth of 1.7 metres. The lake is very shallow in front of the site. The site is approximately 2km from the ocean and 10 km from the ocean entrance.

The development site has elevations ranging from approximately 1.0 m AHD adjoining the foreshore to 9 metres AHD on Main Rd. A site survey is included as **Appendix A**.

Lower parts of the site are likely to be inundated during flood events.

2.0 description of the proposed development

2.1 THE DEVELOPMENT

The development will comprise 53 units for seniors. The building will be setback 20 metres from the property boundary and approximately 25 metres from Lake Budgewoi.

The minimum habitable floor level of the proposal is 3.1 metres AHD. Car parking and access to the lowest level units will also be at 3.1m AHD. The car park entrances will be at approximately 6 and 9 metres AHD respectively.

Rainwater tanks will store roof run off. All roof and driveway water leaving the site pass through the site treatment system. Some stormwater will flow across landscaped areas adjoining the foreshore to the lake. An erosion and sediment control plan has been prepared for construction works on the site.

3.0 policy requirements

There are a range of policies relevant to coastal issues and the proposal.

3.1 SEPP 71 – COASTAL PROTECTION

The provisions of SEPP 71 are relevant but are addressed elsewhere as a statutory consideration.

3.2 NSW COASTAL POLICY

The provisions are generally relevant but are addressed elsewhere as a statutory matter. There are no specific policy requirements applying to the proposal.

3.3 NSW COASTLINE MANAGEMENT MANUAL

The site is not located on the open coastline but is located on an estuary. The appropriate document is the NSW Estuary Management Manual 1992. An estuary management study has been prepared for the Tuggerah Lakes in accordance with the manual.

3.4 TUGGERAH LAKES ESTUARY MANAGEMENT STUDY (EMS)

The EMS identifies a range of management issues for the Tuggerah Lakes system. The EMS was preceded by an estuary processes study. Issues relevant to the current proposal include:

- drainage;
- sedimentation;
- wrack (seagrass and algae that collects and decays along foreshores causing recreation amenity problems);
- degraded foreshore vegetation; and
- protection of ecology and seagrasses.

Foreshore erosion/recession is not identified as problem. Wave action on the lakes is not identified as a problem. As the image of the foreshore below shows, wave action is not significant in this location, refer to plate 1.

Plate 1 Part of the foreshore adjoining the site.

3.5 NSW FLOODPLAIN MANAGEMENT MANUAL 2001

The manual sets out the NSW governments policy approach to flooding.

The site would be categorised as low hazard flood fringe where flooding is less than 0.8 metres depth and high hazard flood fringe where flooding is greater than 0.8 metres depth.

Under the Interim Development Guidelines contained in the Manual the proposal is residential infill development.

Relevant development considerations include:

- Any portion of the building or structure below the Flood Planning Level (FPL) should be built from flood compatible materials; and
- The habitable floor levels of new residences....should be either above the FPL or be flood proofed to this level.

3.6 WYONG COUNCIL

Wyong Council has advised that its minimum habitable floor level for development adjoining the Tuggerah Lakes is 2.7 m AHD.

This level is made up of a 1% AEP flood component of 2.2 m AHD plus a freeboard of 0.5 m. Wyong Council is in the process of reviewing flood levels to take account of climate change developments. The current Flood Planning Level for the site is taken to be 2.7 metres AHD.

The habitable areas of the proposal at 3.1 m AHD are a minimum of 0.4 metres above Councils FPL and thus complies with the Interim Development Guidelines and meets current flood policy requirements.

3.7 PRACTICAL CONSIDERATIONS FOR CLIMATE CHANGE DECC 2007

Climate change is expected to increase flood risk in coastal areas through a combination of increased rainfall intensities and sea level rise.

The purpose of the guidelines is to inform floodplain management projects. DECC recommend that sensitivity analyses be carried out to establish if climate change is a significant issue for the location. Three scenarios are recommended for sensitivity analysis being sea level rises of 0.18 metres, 0.55 metres and 0.91 metres. These rises correspond with low, medium and high level impacts respectively. Although these sensitivity analyses are for flood modelling associated with flood plain management studies they can be used as a guide to potential impacts on individual developments.

The sensitivity analyses should also include rainfall intensities increases of 10%, 20% and 30%. The indicative rainfall changes for the Hunter Central Rivers Catchment are -10% to + 12% for 2030 and -7% to + 10% for 2070. These ranges are for 40 year 1 day rainfall totals.

3.8 DRAFT SEA LEVEL RISE POLICY STATEMENT (NSW GOVERNMENT FEBRUARY 2009)

The draft policy addresses permanent sea level rise and the resulting increased coastal hazards and flooding risks during major storms.

The draft policy sets out 5 principles for minimising the socia, economic and environmental consequences of long term sea level rise.

The 5 principles are (in summary):

- Promote an adaptive risk-based approach;
- Provide guidance to local Councils;
- Encourage appropriate development;
- Continue to provide emergency management for floods and storms; and
- Continue to provide updated information.

Planning and investment decisions should be based on the life of an asset. The benchmarks adopted by the policy are sea level rises of 40cm by 2050 and 90 cm by 2100. Development affected by sea level rise should be able to accommodate projected impacts, over time, through appropriate site planning and design.

The life of the proposed asset is assumed to be a minimum of 60 years but could be longer.

3.9 LAKE MACQUARIE SEA LEVEL RISE AND PREPAREDNESS & ADAPTION POLICY 2008

The local government area immediately to the north is Lake Macquarie which also has an extensive estuarine lake system and has adopted a seal level rise policy.

The Lake Macquarie Policy addresses floor levels for habitable rooms taking into account 1% ARI, freeboard, rainfall increases, and sea level rise. Freeboard is discounted by 20 cm because of the separate consideration of climate change. Building life is assumed to be a minimum of 50 years and a maximum of 100 years.

3.10 TRINITY POINT DEVELOPMENT PROPOSAL LAKE MACQUARIE

Issues related climate changes were addressed by Patterson Britton 2008 for a proposed marina and tourist development at Trinity Point on Lake Macquarie. Matters such as wave run up, increased rainfall and raised still water levels were assessed in accordance with the DECC guidelines.

It was concluded the development had reduced sensitivity to climate change due to a number of factors:

- the location on the edge of the lake where there would be no increased flood flow velocity;
- the increase in flood hazard could be effectively managed by implementing flood evacuation procedures; and
- any increase in damages would be limited to privately owned structures and infrastructure.

The report found that flood warning and flood preparation measures such as removing cars from carparks would be required. The long time taken for the flood peak to be reached gave time to implement these measures. These were seen as cost effective mitigation measures.

The Trinity Point example can provide a general guide but the specific calculations in relation to changes in flood levels are not directly transferable to Tuggerah Lakes.

4 Assessment of Coastal issues

The site is potentially affected by sea level rise, increased flood risk due to sea level rise and foreshore management issues. The potential scope of these issues is assessed below.

4.1 THE EFFECTS OF BENCHMARK SEA LEVEL RISE

The predicted benchmark sea levels rises are 40 cm (0.4 m) by 2050 and 90 cm (0.9 m) by 2100. This gives a maximum still water level of the Lake under normal conditions of about 1 m AHD by 2100.

The property boundary is at approximately 1m AHD. The minimum floor level of the proposal at 3.1 metres AHD will be some 2.1 metres higher than the increased lake level.

Under the 2100 predicted benchmark it is expected that the shoreline and lake level would be at the current 1m AHD contour of the site. The risk of additional shoreline recession is low due to the generally higher stability of shorelines within the lake system. The major shoreline recession risk is to ocean beaches.

The site and the development are under no significant threat from the effects of the predicted benchmark permanent sea level rise to 2100.

4.2 INCREASED FLOOD RISK DUE TO SEA LEVEL RISE

The proposal is assumed to have an economic life of 60 years to 2070. It is however possible that the building would still be in use in 2100.

At present the adopted 1% AEP flood level for the site is 2.2 m AHD. The FPL is presently taken to be 2.7 metres AHD. At present there is a margin of 0.4 m or 40cm for absorbing increased flood risk to the lowest floor level of 3.1 metres AHD.

The effect of increased rainfall intensities has not been modelled yet for the Tuggerah Lakes catchment. It is possible that increased rainfall will increase the duration rather than the level of flood peaks, also the flood behaviour in the Lakes may change with sea level rise. There remains significant uncertainty as to likely peak flood levels in Tuggerah Lakes under the benchmark scenarios of 40 cm and 90 cm sea level rise.

In the circumstances flood levels can be estimated by adding sea level rise to FPLs . This is an extremely conservative estimate since flood storage will increase at a greater rate than the elevation increase associated with sea level rise. The accuracy of estimates will be increased when revised flood information is available and, as over time, the actual rates of sea level rise are tracked.

Assuming that sea level increase will be a linear proportional increase with elevation, an idea of the effects of sea level rise on flood levels for the site can be gained from Table 1 below. Once full allowance for sea level rise is made, freeboard can be discounted by 20 cm. The attached plans show how the lake level, 1% AEP flood level and FPL could be affected by sea level rise.

For the purpose of the current proposal flood risk increase from sea level rise is categorised in the table below:

RISK LEVEL	RISK CRITERION
no risk increase	ground floor at or above estimated FPL (sea level rise below 0.6 metres)
low risk increase	ground floor level below estimated FPL (sea level rise greater than 0.6 metres)
moderate risk increase	ground floor level below estimated 1% AEP event (sea level rise greater than 0.9 metres)
significant risk increase	inundation of ground floor by more than 0.8 metres in 1% AEP event (sea level rise greater than 1.4 metres)

The risk criteria for the effects of potential sea level rises on major flood events have been derived from current flood policy settings and address both planning risk and flood hazard.

Applying the risk classes to the minimum floor level of the proposed development yields the following results.

- The risk of flooding to the ground floor of the proposal in extreme flood events will be increased by the effects of sea level rise.
- There is no flood risk increase to 2070 which is the economic life of the building.
- From 2070 to 2100 the flood risk increase is low.
- After 2100 the flood risk increase would be in the moderate range but is outside the bench mark range.
- After 2150 flood risk would be in the significant range, this is equivalent to a sea level rise of 1.4 metres but is well outside the benchmark range and well outside the economic life of the building.

4.3 COASTAL MANAGEMENT ISSUES

Based on the Tuggerah Lakes Estuary Management Study the coastal issues relevant to the site but not significant in the circumstances are:

- Degraded foreshore vegetation (the site has been developed for urban use);
- Drainage (no direct drainage to the lake is proposed);
- Protection of seagrass (no works will occur beyond the site and no ongoing effects from the proposed use of the site are likely); and
- Sedimentation (controls on construction will apply).

The proponents intend to lodge a separate application for a jetty including a lease over the foreshore area which will addresses foreshore management issues.

4.4 FORESHORE MANAGEMENT

The current property boundary is inland of the foreshore by approximately 6 metres. The foreshore area is Crown land. Wrack has accumulated along the foreshore and decayed forming organic ooze. The problem may be managed with foreshore works.

Wyong Council has indicated a preference for establishing saltmarsh on the foreshore if this is practical. As this area is outside the site no management is proposed as part of this proposal.

4.5 FLOOD MANAGEMENT

Flooding risk to the site is likely to increase over the lifetime of the project as a result of sea level rise.

Based on the draft policy 2009 the principles that apply to the proposal are:

- Adaptive risk based management; and
- Appropriate development and site design.

The DECC guidelines, which provide more detail, identify the issues that should be considered in deciding on an appropriate climate change management plan (adapted for a single development) are:

- Does climate change impact on the area practical for development?
- Does the option provide a suitable level of protection?
- Does the flood hazard alter with climate change?
- Is any additional hazard significant?

- Can hazard be successfully and practically managed?
- Will sea level rise affect the habitability of the site?
- Will there be extra flood damage?
- What extra cost is involved?
- What additional emergency management will be required?

The risk assessment finds that there is no significant increase in predicted flood risk over the economic life of the proposal and on to 2100 as a result of climate change effects.

Flood management implications for the proposal

Currently there is no appreciable increase in flood risk for the economic life of the proposal. The level of increased risk of flooding from major storm event is estimated from no impact presently to low impact by 2100.

At present the increased flood risk to the proposal is acceptable.

Should information become available that suggests that the increase in flood risk will become unacceptable then the following adaptive management options are potentially available without affecting the majority of the development:

- Flood proofing of the affected units;
- Evacuation procedures; and
- A wall / levee on the site protecting affected lower ground floor units.

Since there is no significant increase in risk and there are reasonable adaptive management options available then the proposal is appropriate development for the site. No additional emergency management is required.

4.0 conclusion

A SEPP SL development is proposed on a near foreshore site at Toukley. The site is close to the foreshore of Lake Budgewoi and is affected by flooding and potential sea level rise.

Being located next to a shallow estuary the site is not exposed to any significant coastal erosion or recession hazard.

A strip of crown land that is not publicly accessible lies between the site and the lake. Foreshore management issues will be addressed through a separate development application.

The lower sections of the site are subject to flooding but the proposed minimum floor level of 3.1 m AHD is some 40cm above the current Flood Planning Level of 2.7m AHD.

Sea level rise will potentially encroach the property boundary by 2100. The proposed development is unlikely to be affected by general sea level rise to predicted benchmark levels.

The site is affected by increased flood risk when sea level rise is considered. New draft benchmarks for assessing flood risk increases due to climate change have been set by the NSW Government at 40cm by 2050 and 90cm by 2100. Assessment has found that there will not be a significant increase in flood risk to the proposal before 2100. No flood mitigation measures are justified at present but adaptable management options are available for the future should they be required.

The sensitivity of the proposed development to sea level rise is assessed as low.

Plan of: POTENTIAL SEA LEVEL RISE EFFECTS Location: MAIN ROAD
TOUKLEY
Council: WYONG

Datum:	AHD	Date:	30th March 2009	Version:	A (30th March 2009)
Origin:	PM 17507	Sheet:	3	Client:	
Projection:	MGA (approx)	Plan by:	MS	Survey:	
Origin:	DCDB	Project Manager:	I.McN	AutoCad:	N:\36418da-1a.dwg
North Direction:	Grid	Office:	Hunter	Our Ref:	36418
Contour Interval:	0.5m	Plan Purpose:	EA		

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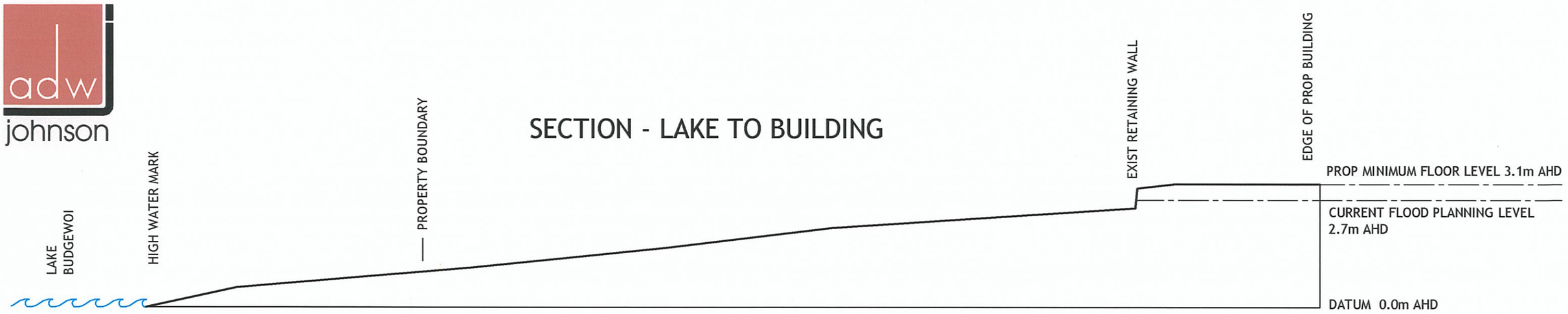
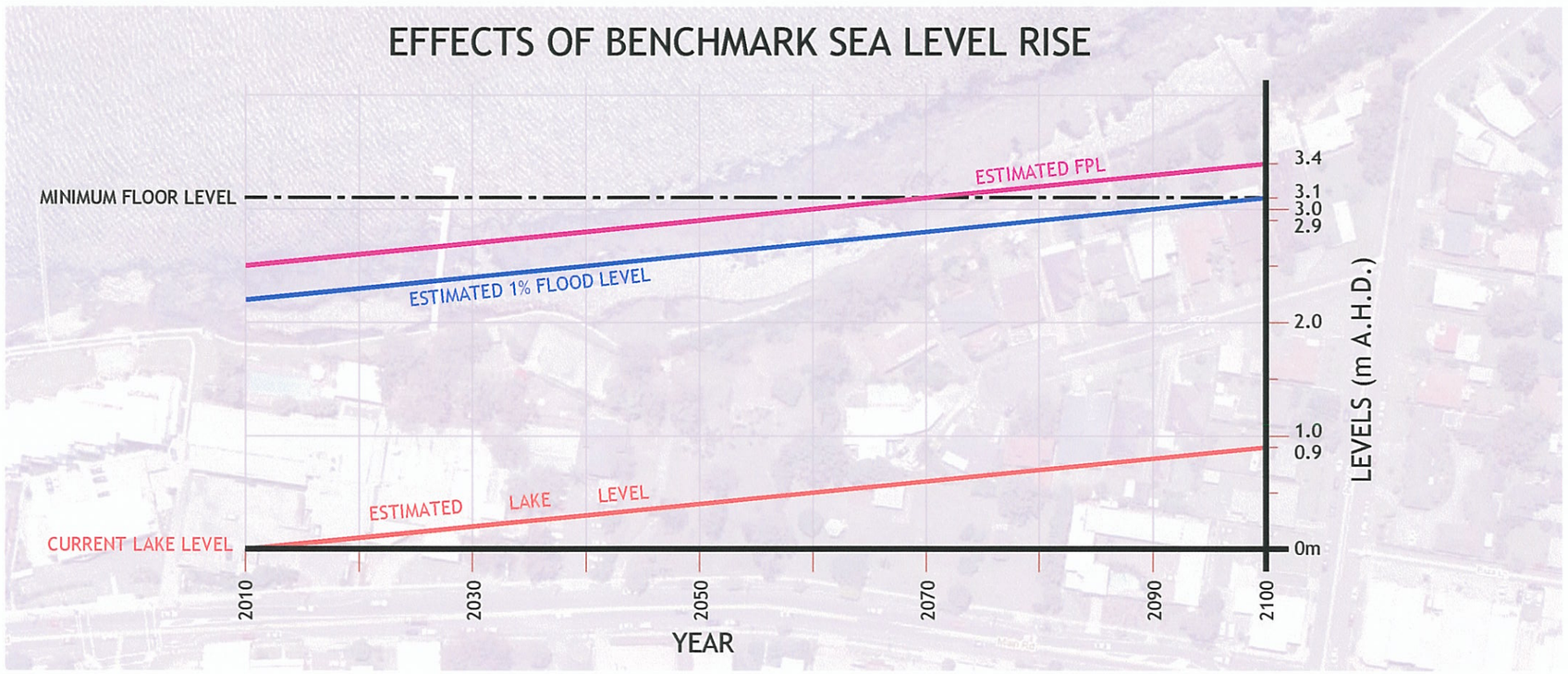
SECTION - LAKE TO BUILDING



EFFECTS OF BENCHMARK SEA LEVEL RISE



Ver.	Date	Comment
A	1/4/2009	First draft

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Plan of:	FLOOD RISK AND SEA LEVEL RISE	Location:	MAIN ROAD TOUKLEY	Datum:	AHD	Date:	30th March 2009
				Origin:	PM 17507	Sheet:	4
				Projection:	MGA (approx)	Plan by:	MS
				Origin:	DCDB	Project Manager:	I.McN
		Council:	WYONG	North Direction:	Grid	Office:	Hunter
				Contour Interval:	0.5m	Plan Purpose:	EA

Version:	A (30th March 2009)		
Client:			
Survey:			
AutoCad:	N:\36418da-1a.dwg		
Our Ref:	36418		

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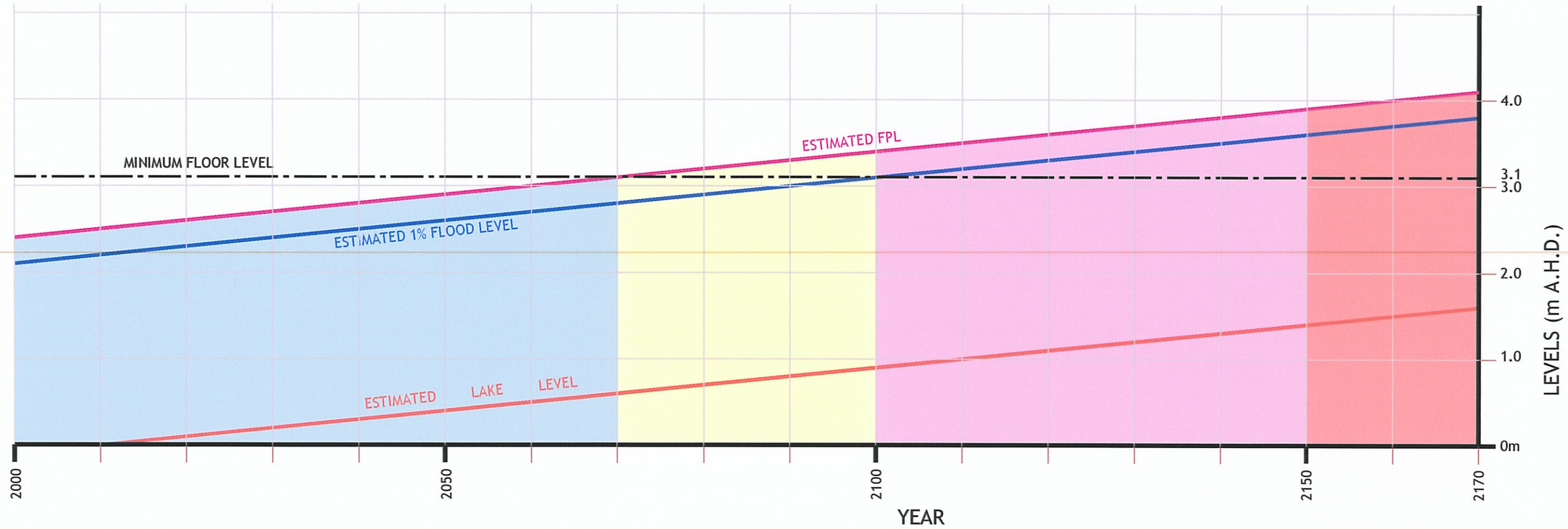
TOUKLEY SENIORS LIVING
FLOOD RISK ASSESSMENT



LIMIT OF BENCHMARK SEA LEVEL RISE CONSIDERATION

FLOOD RISK INCREASE

- SIGNIFICANT
- MODERATE
- LOW
- NO INCREASE

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