

Lake Macquarie Sea Level Rise

Analysis

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1.0 The Background

Over the years the required minimum height for floor levels has been increasing in LMCC. In 2003 for my first job in Swansea the minimum floor level was 1.5m Australian Height Datum (AHD). From 2007 LMCC required that for housing and Commercial that the floor level was to be at a minimum of 1.9m AHD. It then went up by 2010 to 2.27m AHD (Note: AHD is from mean sea level pegged as 0 in 1971).

This year I was made aware of a new higher minimum level of 2.36m AHD applied by LMCC to both housing and commercial. The level for medium density is even higher at 2.82AHD

1.1 The levels: LMCC & the CSIRO

From the LMCC website:

“Scientists predict global sea levels will almost certainly rise by **0.59 metres** by the end of this century. This is assuming we do not significantly change our lifestyle and continue to produce high levels of greenhouse gases.

Further research by the **CSIRO** shows that by 2100, levels on the east coast of Australia will be about **0.14 metres** higher than the global average, due to effect of the warm East Australian Current. Sea levels may rise another 0.20 metres as glaciers and land-based ice sheets melt. Water levels in Lake Macquarie are expected to rise at the same rate and to the same level as the ocean.

Expert advice from the **NSW Government** uses these predictions to calculate a level for coastal planning of, in round figures, a rise of 0.9 metres by 2100.

Year 2050 flood level (1% chance per year) 1.86 metres AHD

Year 2100 flood level (1% chance per year) 2.32 metres AHD

Year 2050 flood planning level 2.36 metres AHD

Floor height for new low-density residential and commercial developments

Year 2100 flood planning level 2.82 metres AHD

Floor height for new medium density residential, and mixed use developments.

LAKE MACQUARIE WATERWAY FLOOD STUDY

<http://www.lakemac.com.au/downloads/4474E6D964E67E8CD196ED48548495DA82BE73CC.pdf>

2.0 Some consequences of new levels in Lake Macquarie

A level of 1.5m AHD seemed like sensible planning, and had minimal impact overall, whereas a level of 2.36m AHD affects large areas.

2.1 Swansea

In Swansea town centre the ground level is about 1.2m AHD. I have three jobs all with ground levels at about 1.2m AHD. In 2010 LMCC enforced the 2.27m AHD floor level for a house. For the house with aging residents, the residents accepted the 1m high steps to their single storey house philosophically. They accepted how high their house was above their neighbour.

For a mixed use commercial property, in 2007 the 1.88m AHD was applied resulting in significant ramping. It was refused as they were told to amalgamate with a neighbour. But June 2008 at a meeting with LMCC's senior planner John Andrews and the two clients to discuss issues of amalgamating two sites, he said that they would need to consider a level 0.91m above 1.88m AHD (Michell Bisson confirmed in writing that this was not a certain level but that they were raising it to accommodate Sea level rise). Both owners of properties on Josephson Street were amazed as it implied water in the streets of over 1.2m. It scuttled the job entirely as at 1.2m above natural site levels there was no possibility of a good street connection for commercial use. Combined with the height limit, the 3rd floor dropped off reducing viability also.

The new level of 2.36m and 2.82m AHD for mixed use means that much in Swansea will have floor levels over 1m above footpath levels with mixed use with floors over 1.5m above footpath. Most people eye levels are about 1.2-1.5m. This will make hardship for aged access. It will destroy commercial connection. The planner had no answer when asked, 'what was to be done for services?'

2.2 Marks Point

The ground level is low. One site had levels of 0.4m - 0.6m AHD. Council enforced 1.9m AHD in 2007 with a garage at 0.97m AHD. I solved it with floor at 900mm above half a metre of fill. In 2008 the job fell victim of the GFC. This year new clients sought to modify the design to meet their needs.

The new 2.36m ADH minimum level would mean that the floor level would be a staggering 1.9m above natural ground. The clients chose to put in a section 96 and keep the old plans.

The new LMCC garage level is 1.61m AHD. It would have required over 1m of fill over the entire site and have flooded the neighbour every time it rained. After much negotiation a special dispensation of 1.3m AHD for the boat shed was granted. 1.61m for garages for the low lying parts of Marks Point means even garages might be up to 1m above natural ground which will increase costs.

2.3 Blacksmiths

Levels on the main street are about 1.5m AHD. Nothing much new has been built there for a long time. A level of 2.36m places the floor 800mm above the street. It results in over 11m length of ramp for disabled access. Perhaps if people accept that floors may be 0.7-0.8m above the ground the new levels may not worry too many people. However it still involves extra cost to build and it reduces the attractiveness to older people who would not wish for so many stairs. It will rule out most extensions connecting to houses. It will rule out alfresco living connected to the backyard.



Figure 1 As designed at RL 1.83AHD



Figure 2 As required by LMCC minimum floor level of 2.36AHD

These are not *unique* sites in a few places. These are representative of much of the suburbs mentioned. These conditions affect large areas of LMCC with many existing houses and businesses.

The most critical outcome is that it will prevent development of Swansea and Blacksmith town centres. It will prevent extensions to houses. It is now affecting insurance of whole areas.

Is the level reasonable, considering the real risks?

3.0 How is the level of 2.36m derived?

Greg D Jones Senior Sustainability Officer of LMCC in a phone conversation told me that the level is based on planning for a 1:100 year flood of 1.5m AHD plus 0.49m for sea level rise by 2050 plus a freeboard (0.37m).

3.1 What is known about flood levels?

A search on LMCC website found these facts,

"The highest recorded lake water level is 1.25 m AHD in 1949 (at Marks Point), with 1.05 m AHD reached in the June 2007 long weekend storm/flood event and 1.00 m AHD in February 1990.

The June 2007 long weekend storm/flood event, and the February 1990 flood event were of the order of a 30 year Average Recurrence Interval (ARI) design event.

The water level in the lake is typically at 0.1m AHD but can rise to 0.4 m AHD following a period of high ocean levels.

High tide varies from approximately 0.5 m to 1.1 m AHD [with up to 1m storm surge and wave setup possible].

<http://www.lakemac.com.au/downloads/D4253E495A0D95A15FAE74F4251CBA2A44F4E0EF.pdf>

As far as records go back, the lake has never flooded to 1.5m AHD. The 1.25m flood level of 1949 was local at Marks Point. Stormwater rises to exit a narrow channel.

3.2 The 1 in 100 year design level in LMCC

A draft document from LMCC on the NSW Government website in association with the Local Government Association,

The modelled 1% Average Exceedance Probability (AEP) flood level for the lake is 1.38m AHD.

<http://www.environment.nsw.gov.au/resources/climatechange/Lakemslr.pdf>

To increase from 1.38m to 1.5m AHD implies a *rain event* that delivers an *extra* 120mm of rain over a large area of the catchment. From 0.4m to 1.5m is a 900mm rain event.

During the Queen's Birthday long weekend June 2007, "In Maitland, almost three-quarters of the average monthly rainfall fell in 3 days, with 285 mm recorded between 7 and 9 June." http://www.hcr.cma.nsw.gov.au/uploads/res/FactSheet_5_2007.pdf

If the flood in 2007 with just under 300mm of rain reached 1.05m, to reach 1.5m the catchment must receive in a short time over 700mm of rain. The record so far for Sydney is 327.8mm for the 24 hours to 9am on the 6th August 1986.

<http://forum.weatherzone.com.au/ubbthreads.php/topics/121653/1>.

Newcastle's record is 267mm in 150 minutes in 1871.

<http://www.bom.gov.au/water/designRainfalls/rainfallEvents/ausRecordRainfall.shtml>).

Whereas 300mm to 400mm rain events are reported with Tropical storms known to produce up to 600mm (Burroughs et al, Weather, Five Mile Press, 2008), over 700mm would join record breaking figures from Wongawilli (797mm in a day), Dorrigo, Tomewin and Bowraville (1090mm in 3 days).

<http://www.bom.gov.au/water/designRainfalls/rainfallEvents/ausRecordRainfall.shtml>)

Is the level of 1.5 adding 0.12m for a safety factor?

3.3 Sea Level Rise

The historic sea level rise averaged for all data collected for this part of coast (both Fort Dennison and Newcastle) is a tiny 0.9mm/year. Source: NTC 2007 (<http://soer.justice.tas.gov.au/2009/indicator/21/index.php>)

The latest accurate data shows our part of the coast (from Port Kembla) having averaged a relative rise (which is as experienced) from July 1991 to June 2011 of 2.6mm/yr with a change of net relative trend of +0.5mm from June 2010-June 2011. (<http://www.bom.gov.au/ntc/IDO60202/IDO60202.2011.pdf>)

The overall of 0.9mm/year since records were kept includes the recent increased rate of 2.6mm/year.

The following chart shows why the average is so low. Global average data shows that for some years the mean sea level has dropped.

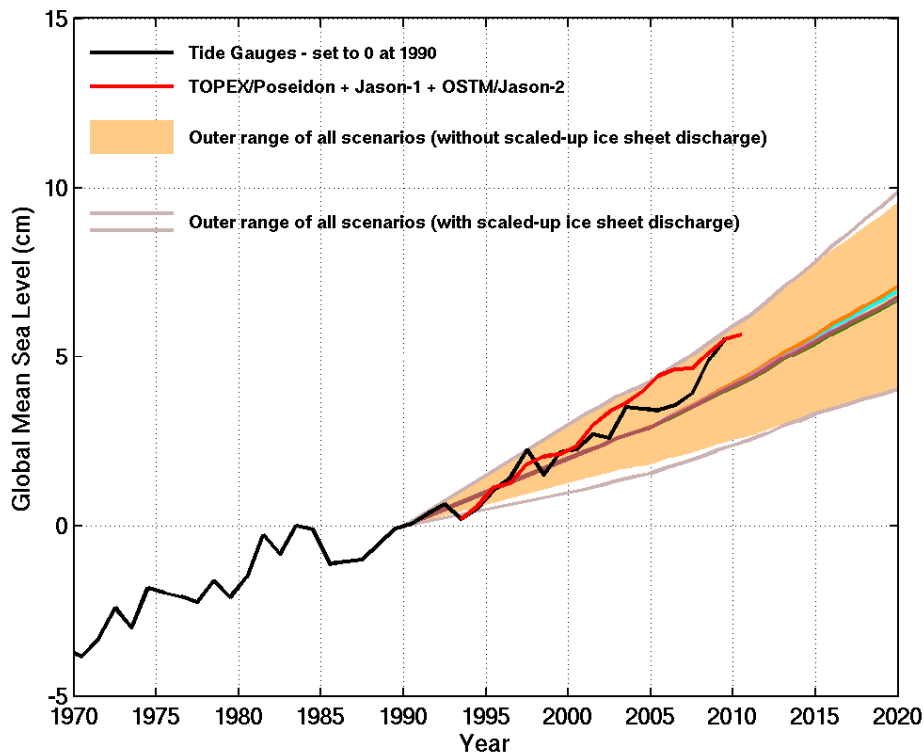


Figure 3 http://www.cmar.csiro.au/sealevel/sl_proj_21st.html
Figure is excerpt for study. Please see context.

Since 1990 average of all the data (which means it does not apply to one place) shows about 60mm of rise in 22 years an average about 2.76mm/year to 3mm/year.

To confirm this,

The CSIRO's John Church, considered one of the world's leading authorities on sea-level rise, told The Weekend Australian yesterday he remained convinced waters along the eastern seaboard were rising in line with global averages. He noted that

the BOM's gauge results for Port Kembla as published here did not include the effect of barometric pressure, which, if included, would lift the sea-level increase to 3.1mm, not much less than agreed global estimates.

The Australian continent was also rising slightly - about 0.3-0.4mm a year around Sydney - which had partially offset increases in sea levels,

<http://www.theaustralian.com.au/news/nation/science-is-in-on-climate-change-sea-level-rise-17mm/story-e6frg6nf-1225795202916>

Barometric pressure pushes the sea down Church mentioned it for comparison, it does not affect *the measurement of 2.6mm/yr*. One reason (among many) that there is such huge variability in sea level rise data from different places about the globe is due to *land movement*. This part of the coast averages a sea level rise which is less than the global average due to land rise.

This graph is of past and predicted average sea rise is from the IPCC 2007 report.

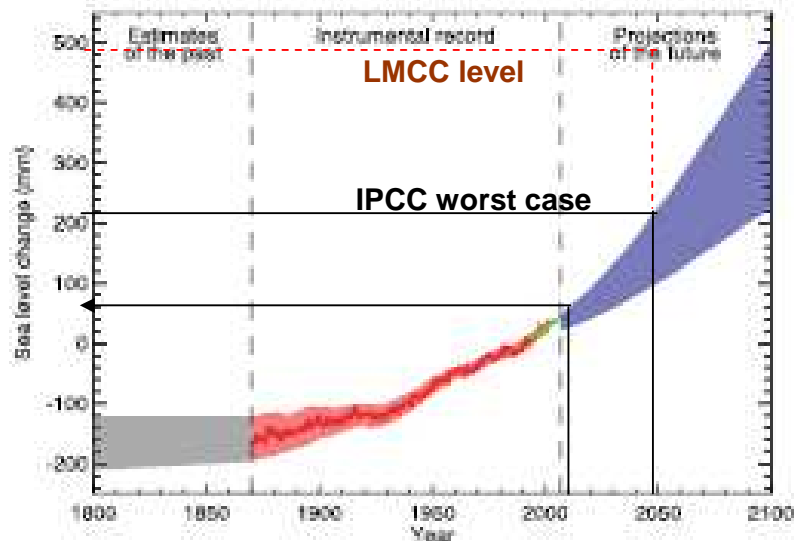


Figure 4. http://www.ipcc.ch/publications_and_data/ar4/wg1/en/faq-5-1.html

On top in red line where LMCC says the water will rise to. LMCC's rise of 0.49m by 2050 is double what the IPCC shows.

To back this graph up a highly regarded group working for the IPCC found recently, "Ice2sea, a four-year project to narrow down uncertainties of how melting ice will pour water into the oceans, found that sea levels would rise by between 16.5 and 69 cm under a scenario of moderate global warming this century [ie 2000- 2100]."

<http://www.reuters.com/article/2013/05/14/climate-ice-idUSL6N0DV2V420130514>

But there is more, LMCC quotes the CSIRO. The CSIRO under a CRC grant teamed up on sea level rise in the ACE CRC. The following graph is from their report.

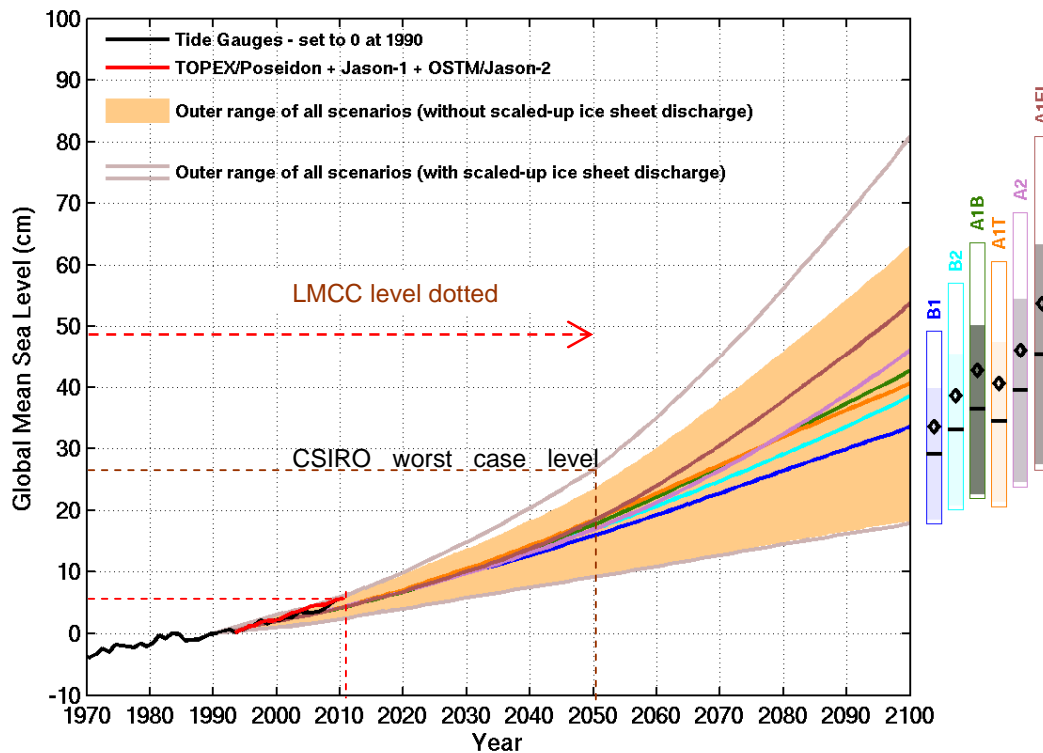


Figure 5 (dated March 2012)

The observational estimates of global-averaged sea level based on tide-gauge measurements and satellite-altimeter data. The projections are based on the Intergovernmental Panel on Climate Change Fourth Assessment Report (IPCC AR4), as reproduced in Church et al. (2011a).

http://www.cmar.csiro.au/sealevel/sl_proj_21st.html

From this graph, by 2050 from 1990 levels there is projected, with accelerated warming, *at worst case* 0.27m sea level rise. From 2011 which is what we see now there is projected about 0.21m average rise. This is global average, which is slightly higher than local measurements. Where does LMCC's 0.49m come from?

Global sea levels are set to rise by 0.18 m to **0.59 m** by 2095 relative to 1990 levels, with potentially an additional contribution from icesheets of 0.1-0.2 m (IPCC, 2007). Based on these figures, and analysis of local factors, many government agencies, such as the NSW State Government, have adopted an estimated increase of **0.9 m** on top of 1990 levels by the year 2100 (DECCW 2009).

http://www.lakemac.com.au/eshoreance/eShoreance_technical_report.pdf

Further research by the CSIRO shows that by 2100, levels on the east coast of Australia will be about 0.14 metres higher than *the global average*, due to effect of the warm East Australian Current. Sea levels *may rise* another 0.20 metres as glaciers and land-based ice sheets melt.

<http://www.lakemac.com.au/downloads/4474E6D964E67E8CD196ED48548495DA82BE73CC.pdf>

Is the figure of 0.49m by 2050 an overestimation by over 0.21m?

3.4 Freeboard

When pressed about the freeboard, Greg Jones of LMCC said it would “not happen”. Freeboard is designed so the predicted flood would be 360mm below the floor.

Freeboard is used on ships so that when there are waves no water enters. The water is not turbulent in a lake flood.

LMCC have adopted State Government use. The following is from the NSW Government’s *Flood Risk Management Guide Incorporating sea level rise benchmarks in flood risk assessments*.

“The **typical 0.5 metre freeboard** outlined in the NSW Floodplain Development Manual (NSW Government 2005) for general residential development provides a factor of safety to ensure that the risk exposure selected is accommodated. This freeboard includes a component related to climate change impacts on flood levels in coastal and non-coastal areas and a wide variation in sensitivity of estimated flood levels to flood flow. The freeboard provides a relatively small allowance to accommodate some of the projected increases in rainfall intensity from flood-producing storm events associated with climate change

Where flood modelling has been undertaken, it can be updated to include the sea level rise planning benchmarks or a conservative assumption can be made about sea level rise impacts. Where the site is below 4 metres AHD, an appropriate conservative assumption to estimate the 1% AEP flood level considering sea level rise is to add the sea level rise planning benchmarks to the 1% AEP flood level relevant to the site.

<http://www.environment.nsw.gov.au/resources/water/coasts/10759FloodRiskManGde.pdf>

Why is there a need for freeboard in water which is not turbulent? The term ‘freeboard’ however is used for a factor of safety for increase in rainfall intensity.

Is there any evidence there has been in increase in rain intensity to justify 0.37m for a lake already with factor above the highest recorded level?

This issue has been raised with the local State Government minister.

4.0 Federal Government and LMCC flood levels

LMCC refers to the Federal Government,

“Different organisations have adopted slightly different rates of sea level rise, depending on predictions for increases in greenhouse gases and the rate of ice melt. Commonly adopted rates range from 0.90m (NSW Government) **to 1.1m (Commonwealth) by 2100 on 1990 levels**. Some Councils have also adopted levels specific to their coast and waterways. For example, Lake Macquarie City Council had adopted levels of 0.41 metres by 2050 and 0.91 metres by 2100.” Stevens, H http://www.lakemac.com.au/eshoreance/step_1.aspx

But on Federal Government sites the level of 1.1m rise by 2100 from 1990 is not given as *certain*, but as only one scenario of three.

Maps are available to show three sea level rise scenarios: low sea level rise (0.5m), medium sea level rise (0.8m) and high sea level rise (1.1m). These sea level rise scenarios are for a 2100 period, relative to 1990.

http://www.ozcoasts.gov.au/climate/sd_visual.jsp
<http://www.climatechange.gov.au/climate-change/adapting-climate-change/australias-coasts-and-climate-change/mapping-sea-level-rise>

A critical document is the “LAKE MACQUARIE WATERWAY FLOOD RISK MANAGEMENT STUDY and PLAN” June 2012.

The present review was initiated by Lake Macquarie City Council to reassess flood risk management options and incorporate the NSW Government’s sea level rise benchmarks, based on predictions by the Intergovernmental Panel on Climate Change (IPCC) and **the CSIRO**...p2

The background reports are based on peer-reviewed scientific studies that have been incorporated into scientific reviews such as those prepared by the Intergovernmental Panel on Climate Change (IPCC), US National Aeronautical and Space Administration (NASA), Bureau of Meteorology (**BOM**), and the Commonwealth Scientific and Industrial Research Organisation (**CSIRO**),p36

Generally, Government funding is only available for voluntary purchase of buildings that **are frequently flooded in a high hazard area**. p58

Legislative and financial options for Council and property owners to help deal with these situations should be raised with the NSW and federal Governments p70

<http://www.lakemac.com.au/downloads/D4253E495A0D95A15FAE74F4251CBA2A44F4E0EF.pdf>

LMCC calls on other government levels to buy those affected, but the issue now is the measurable financial impact LMCC is having on many people without any measurable evidence, that *there will ever be a hazard*.

It has not flooded higher than 1.25m in 1949. If they were regularly being flooded, like Venice, there is a case to raise minimum floor levels. They might also build a sea wall. We might still connect to the land and think of other ways of living with it which might in the end have less impact, *if need be*.

5.0 Slow change, Disaster & Catastrophe

Much of the world's built environment is most dense in river valleys and coastal inlets. Cities are located in locations subject to flooding for pragmatic reasons including trade. The bulk of trade is still by sea. New York City is prone to storm surge. Nobody would think of moving the city, or of abandoning it. Venice floods every year, yet they build new defences, and shore up old piles. Some places are so wonderful we put up with mopping out. Why not here?

Is a flood a risk to life? From LMCC's Waterway Flood Risk Management Study, At Lake Macquarie waterway the absence of high velocities as well as high flood depths (say > 1 m) means that the risk is smaller than in other flood liable communities.

<http://www.lakemac.com.au/downloads/D4253E495A0D95A15FAE74F4251CBA2A44F4E0EF.pdf>

The risk to life due to lake flood is minimal.

With sensors measuring a slow paced sea level rise, it is not going to be a *disaster*. Monitoring now shows fears of the 1990's have not materialised. From 2012 to 2050 is only 38 years (20% of the way to 2050 and 10% to 2100). There has been no rapid increase. The measurements are within expected variation.

By contrast cyclones and storms that deliver rain events over 300mm over a large area in 2-3 days, hailstorms, waterspouts that come onto land and earthquakes are disasters. These affect insurance. In another category is catastrophe, such as global quake, meteor strike and a tsunami. For these there is no insurance possible.

A design flood level of 2.36m AHD says that *it is problem, a hazard*, to that level. Why introduce a level now when in 5 years it may be *proven* to be unreasonable?

6.0 In a Christian and Scientific Context

Saving the planet has much in common with the fervour of evangelical religion. There is *future predicting*, and the emphasis is on saving *others* lives and responsibility.

Catastrophic events are termed Apocalyptic. Much of the Apocalypse has been fulfilled in political events. But there are passages in the Hebrew prophets that speak of war, hail and a huge quake in the Jordan Rift Valley that shakes earth. There is a *climate* of imagining catastrophe, not limited to Christians.

Those who prepare the IPCC reports are subject to the rigours of critical analysis. Science as a *discipline* as we know it emerged from Robert Boyle, who, as a practising Christian seeking objective truth, helped establish the Royal Society to independently test all findings. Due to this all theory now *depends on data*.

It is the glory of God to conceal a thing: but the honour of kings is to search out a matter. (Proverbs 25:2)

The Law of the Bible is slotted into modern law with concepts of 'making good'. The earth is a gift we care for, as the earth is the footstool of the One who gives us life.

The heaven, even the heavens, are the LORD'S: but the earth hath he given to the children of men. (Psalm 115:16)

From the 2001 and 2007 IPCC reports I now believe that my God the Holy One of Israel controls the movement of clouds, as they have found that they behave in modes that can only be modelled by probability (which eliminates any hope of certainty in models). Isaac Newton realised there was a moment-to moment application of a huge force keeping planets rotating. I now value a Power that day to day controls the clouds, rain, hail and storm, the sum of which is *climate*. Everything is moving and changing; land, sea, air. Without the fears for the future, leading to millions being spent on research, many things would *never have been found out*.

This is presented in the spirit of truth finding, with respect for authority enjoined on all Christians.

8.0 Findings and Further Work

The change in minimum floor level from 1.9m to 2.36m (2.82m) AHD has impact in terms of accessibility and liveability, and it also has a measurable economic loss now.

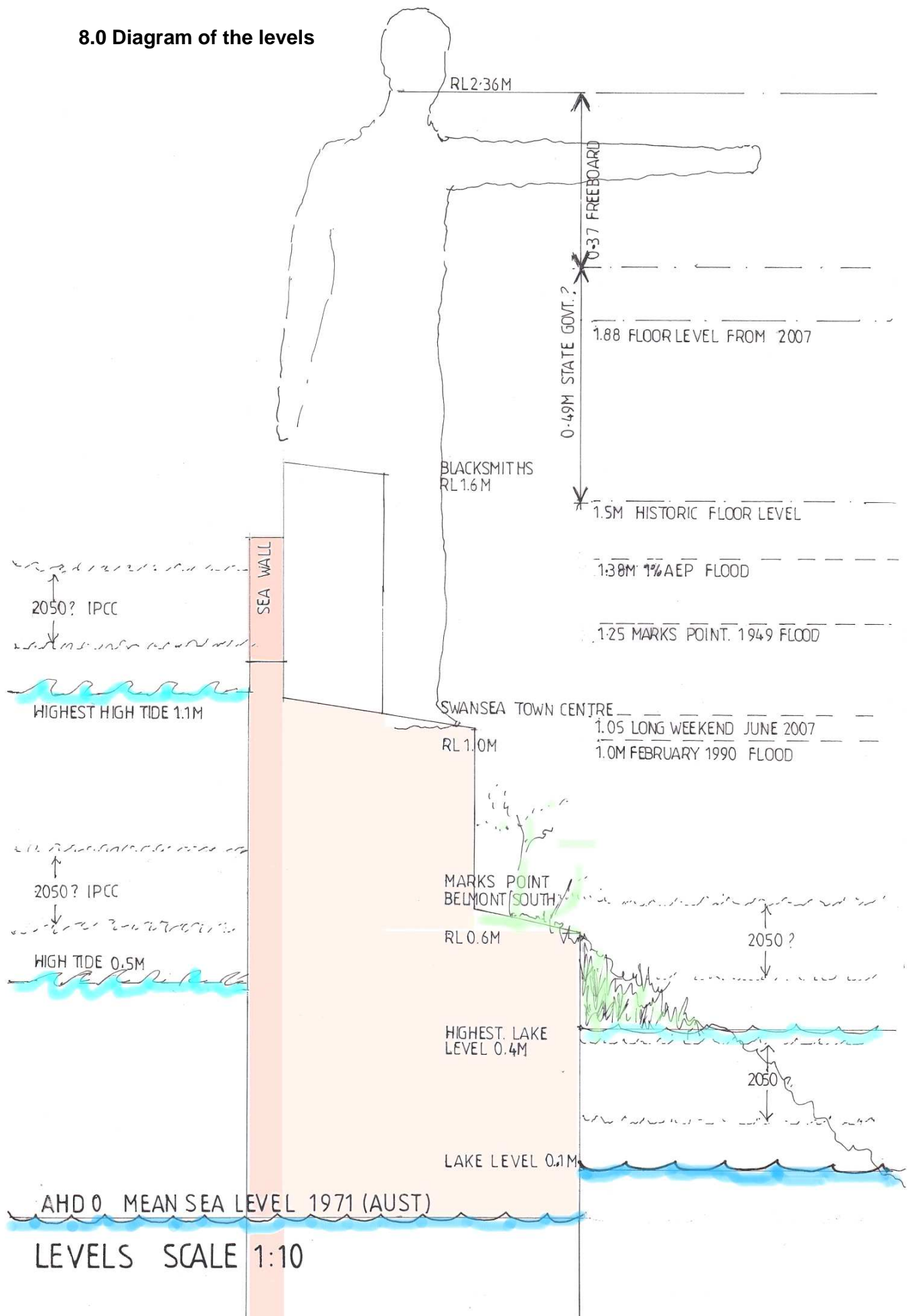
The 2.36m level is derived by adding worst case to worst case scenarios set in place previously by state government, and from a CSIRO report, *plus a freeboard*.

- Should the values all with factors of safety be *overlapping* not added?
- Is the 1% AEP flood reasonable when the historic evidence is 1.25m?
- Has the 0.49m figure for sea level rise by 2050 been not just peer reviewed but independently validated by data?
- Is a freeboard justified when water is not turbulent?
- Is adding 'freeboard' as a factor of safety right when there is a factor of safety?
- Why should drastic action be taken now when for 20 years the levels have only shown slow rise and it is monitored?

The measured data historically of 0.9mm/year and recently of 2.6mm/yr, and previous flood levels is not supporting the worst case scenario. In less than 5 years it is going to be obvious that the sea has not risen as predicted to warrant 2.36m.

The Federal Government maps, though clear, might not be being used as intended. They do not take into account possible remedial action.

8.0 Diagram of the levels



Appendix: Former State Government referenced by LMCC

I will quote a document recently downloaded from the LMCC website:

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But a critical document is the “LAKE MACQUARIE WATERWAY FLOOD RISK MANAGEMENT STUDY and PLAN” June 2012. I will quote,

The present review was initiated by Lake Macquarie City Council to reassess flood risk management options and **incorporate the NSW Government’s sea level rise benchmarks**, based on predictions by the Intergovernmental Panel on Climate Change (IPCC) and the CSIRO...p2

*Review strategic land use planning .. Responsibility: Lake Macquarie City Council **and NSW Government**. Timeframe: by the year 2013.

*Undertake a review of the suitability of slab on ground construction.....

Responsibility: Lake Macquarie City Council and **NSW Government**

Timeframe: by the year 2014. p7

..in light of the **NSW Government’s benchmarks for sea level rise** as well as guidelines for rainfall intensity increases p10.

Design flood levels for the year 2050 and year 2100 have been modelled in the current 2012 Lake Macquarie Waterway Flood Study (Reference 6) and are provided in Tables 6 and 7.

The criteria for establishing these are:

The **NSW Government’s benchmarks in the 2010 Flood Risk Management Guide** (Reference 3) for sea level rise by the year 2050 (+0.4 m) and the year 2100 (+0.9 m) were adopted ... p17.

Lake Macquarie City Council has had a development control policy for flood liable land for over 30 years. It has varied over those years in response to more

information becoming available and as a reflection of **NSW Government policy**.
p19

The **NSW Government** has introduced a set of benchmarks for the assessment of raised sea levels and guidelines for increases in design rainfall intensities (Flood Risk Management Guide - Reference 3 and Floodplain Risk Management Guideline –Practical Consideration of Climate Change – Reference 4). p21.

Both **NSW State Government Policy Statement (2009)** and Lake Macquarie City Council Policy (2008) require Council to include consideration of sea level rise when planning for new developments. **The NSW State Government Sea Level Rise Policy Statement (2009)** requires Council to use benchmarks of 0.4 metres of sea level rise by 2050, and 0.9 metres of sea level rise by 2100. These are the levels that have been adopted in the Lake Macquarie Waterway Flood Study. The basis for these levels is set out in Technical note: Derivation of the NSW Government’s sea level rise planning benchmarks (2009). p36.

3. Flood Risk Management Guide Department of Environment Climate Change and Water NSW, August 2010

4. Floodplain Risk Management Guideline - Practical Consideration of Climate Change. NSW Department of Environment and Climate Change (DECC), October 2007

5. Floodplain Development Manual. NSW Government, April 2005

14. NSW Coastal Planning Guideline: Adapting to Sea Level Rise. NSW Government Planning, August 2010.

<http://www.lakemac.com.au/downloads/D4253E495A0D95A15FAE74F4251CBA2A44F4E0EF.pdf>

The implications are: ‘it’s not us but State Government.’ But is this true? From State Government website:

The 2009 NSW Sea Level Rise Policy Statement is no longer NSW Government policy. <http://www.environment.nsw.gov.au/climateChange/sealevel.htm> *Also* <http://www.planning.nsw.gov.au/PlansforAction/Coastalprotection/SeaLevelRisePolicy/tabid/177/Default.aspx>

How does LMCC not know this? The indications are that they are enforcing State Government policy levels which are no longer current.