

Comments on the North One Hotel Development and Apartments: - as detailed in the Referral Report to NT EPA by BPL Environmental, dated September 2021

Submitted by: Mike Nicholls, Rapid Creek, 2 Nov 2021

Introduction: I wish to comment on how the proposed development will have adverse environmental impacts on three specific areas within, or close to, Lot 7651, Darwin, NT – the area known as Little Mindil.

The three areas are:

- **Area 1:** The area on the north side of the Myilly Heritage Precinct between Burnett Place and the existing fence along the top of the escarpment,
- **Area 2:** The physical escarpment between the existing fence down to the north boundary of the formally defined “Escarpment”,
- **Area 3:** The remaining area of Lot 7651.

The writer’s credentials in relation to these areas and the nature of the environmental impacts:

I have lived most of my 81 years in Darwin. I came here initially because my uncle, Syd Martin, worked in Darwin from 1931 to 1935 as the government auditor for the NT . The house he lived in is left of centre frame in Fig.1, just to the west of Nurses Walk.



Fig. 1 Part of image titled Little Mindil Beach 1945 (Courtesy Heritage Branch, NTG).



Fig 2. The house occupied by my uncle from 1931 to 1935 was one of nine houses built by the Commonwealth Government on Myilly Point circa 1914. That is the kitchen in the foreground. The cook lived in the Kahlin Compound - about 200 m away. (Private collection)



Fig 3. Verandahs surrounded the house. The lady is my grandmother, born 1869. (Private collection)

I include the above photographs because they relate to the “**NT EPA Environmental factors and objectives**” – specifically the environmental objective under the Theme “People” which is to “Protect sacred sites, culture and heritage.”

It is commonly acknowledged that this area has special significance for Aboriginal people - I can remember watching corroborees at or near Little Mindil as a child when I lived in Darwin for a while in 1948. But the point I want to make here is that the area also has special significance for many white people – past and present. Developing the Little Mindil area as proposed, with construction of 7-storey hotel blocks overlooking the Nurses Walk and the Myilly Heritage Precinct, and increasing the density of the already unnaturally thick vegetation on the escarpment (both of which will completely block views and breezes) will destroy rather than protect the cultural and heritage values that are important to me and to many others.

My other credentials relate to evaluating the storm surge risk to the proposed development. I came back to live here with my young family in 1969 to work as the manager of a firm of consulting civil engineers. Since then, I have spent thousands of hours studying tropical cyclones and their associated storm surge with particular emphasis on risks and on public safety. I have authored or co-authored several papers relating to risks to the Darwin public from tropical cyclones. Two that are particularly relevant here are detailed in the References (accessible on-line).

Area 1: The area on the north side of the Myilly Heritage Precinct between Burnett Place and the existing fence along the top of the escarpment: Most of this area is part of the “Escarpment” as defined in a plan within the covenant in the contract between SkyCity Darwin P/L and the Northern Territory of Australia as registered 30 July 2010. (The address of the Northern Territory of Australia was c/o Dept of Lands and Planning, 38 Cavenagh St Darwin, and its delegate for signature was David John Ritchie). The wording of the relevant part of the covenant relating to the rehabilitation and regeneration of the “Escarpment” (not “escarpment”) is attached to this submission in Appendix A.

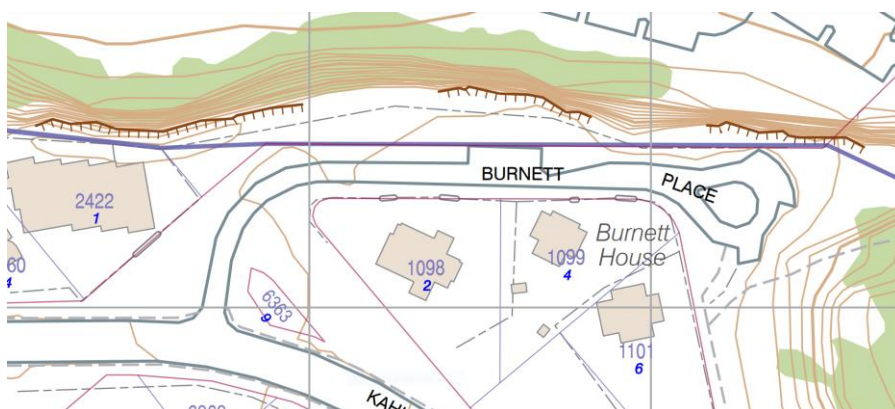


Fig. 4 From the 2500 Topo Cadastre plan from NT Atlas. For scale, the vertical grid lines are 100 m apart. The southern boundary of the “Escarpment” is the thick blue line except:
1) The triangular area on NE side of Lot 2422 is also within the Escarpment - and,

(Caption for Fig 4. Contd.)

2) The Escarpment boundary heads NE from the point I will call “Y” near the right end of the drawing instead of following the blue line to the SE. (The blue line actually marks the boundary between the suburbs of Larrakeyah and The Gardens.) The existing fence near the top of the physical escarpment is shown by the dashed black line. Note that the fence and the Escarpment boundary are coincident for about 50 m west from point Y. The strange, straight, southern boundary to Lot 7651 must date back to the days of lazy surveyors – the boundary should be the fence line – just as shown in the 2014 Concept Plan below.



Fig. 5 Part of the Concept Plan completed by the NT Planning Commission in 2014 showing Proposed Public Open Space extending to the fence line in front of the Heritage Precinct and over the triangular area to the NE of Lot 2422.

Area 1 relates to the “NT EPA Environmental factors and objectives” in two aspects:

The first aspect is under the Theme “People” with the objective “Enhance communities and the economy for the welfare, amenity and benefit of current and future generations of Territorians.” The area between the current Escarpment boundary and the fence is only about 1,200 m² but it used to be a very important area for the public to take a seat, take in the views and enjoy the sea breeze. In the early 1970s, my young family and I lived in a house located on the slopes of Kahlin looking out across Cullen Bay. We would often take our evening walks to the subject area with its north facing views and breezes rather than face the evening glare coming off the sea from across the nearby Cullen Bay. Many others did the same – we were never alone. These days the area also has significant potential to become a popular stopping spot for small (say 28-seater) tour buses that could easily negotiate the

turning circle at the east end of Burnett Place. If people have access to the views, besides being an interesting place to take a break, the site has value to tourists because it helps them gain a mental map of Darwin's non-intuitive layout - with the CBD plateau behind to the south and East Point, the Botanic Gardens, the Casino etc all in view to the north.

The second aspect of Area 1 is under the Theme "Air" with the objective "**Protect air quality**" This relates to what is probably a **significant variation** in the height of the 7-storey hotel block and serviced apartments block.

As a former structural engineer, I was intrigued as to how the biophilic green roofs would stay in place during an intense cyclone, so I googled "green roofs hurricanes" and found: [How Hurricane-Strength Green Roof Systems Can Address Wind Uplift \(livingarchitecturemonitor.com\)](https://livingarchitecturemonitor.com/2021/03/how-hurricane-strength-green-roof-systems-can-address-wind-uplift/) This link is worth looking at – especially the images. It is basically an advertisement for a green roof system designed to withstand 254 kph sustained wind speeds and appears to have been written in March 2021. The system was designed, tested, and approved for use on 25 separate, six-storey student dormitories for the University of Miami. It would therefore appear to be suitable for Darwin, the only catch is that instead of being only the 0.3 m thickness indicated on the architectural drawing for the subject development, these Miami green roofs appear to be about **3 m in height** because they are surrounded by high, double wall parapets to reduce the edge suction loading. (The group image also shows, how ugly these green roofs would appear to the upper storey occupants of the Myilly towers.) The proponent should be required to have a structural engineer with relevant experience explain what these green, biophilic roofs will look like and how they will stay in place during the design cyclone wind event for Darwin, but for here, I will assume that the University of Miami style roofs will be required. This will mean that the top of roof level will increase from 27.0 m AHD to 30.0 m AHD and instead of a view from the top of the escarpment across Fannie Bay to East Point, the proposed development which previously replaced that view with what would appear to be a nearby 3-storey block of flats, would now appear to be a 4-storey block of flats. But I note that the NT EPA does not seem to be concerned with obstruction of views or vistas.

Continuing with the effect of the buildings on **air quality**, the proponent's NT EPA Referral Report includes a figure showing "Darwin Airport Wind Roses" which appears to give annual averages over 24 hours. As Darwin people who rely on cross ventilation to keep cool during the day well know, the critical months are October to December and if you had to choose the critical time as being either 9 am or 3 pm then it is the latter. The current BoM site for such information is [Bureau of Meteorology - Wind Roses \(bom.gov.au\)](https://bom.gov.au/wind/rose/australia/NT/Darwin/) – for the Northern Wet Season at 3 pm, at Darwin Airport shows the winds as: 35% from the NW, 24% from the West, 17% from the north, and insignificant percentages from the other directions. (The equivalents for the 3 pm in the dry season, are from the NW, N and E, with percentages from 20% to 25%.)

This means that the subject area will be more or less downwind of the high buildings during the critical times for catching sea breezes. The **quality** of that air will have two important parameters – its temperature and its velocity.

The temperature at Area 1 will be increased to some extent by the plant exhaust from the air-conditioning of a hundred or more rooms just 100 m or so upwind. I do not know how to evaluate that increase but the proponent should be asked to investigate the matter.

A more critical parameter is the extent to which the velocity of sea breezes at Area 1 will be reduced by the high buildings. The proponent engaged SLR to examine this effect and their desk-top study forms Appendix 18 in the Referral Report. SLR's conclusion (for the 0.3m thick green roofs) was that *"the development will have a negligible impact on the north to westerly sector winds or sea breezes that will impact the southerly buildings on top of the cliff"* I was unconvinced and searched the web for possible calculation methods. The nearest I could find was on the website of an Australian native plant nursery who also design wind breaks, etc. for large rural properties. The website is <https://www.warriapendi.com.au>

Using their method, the height of the "wind break" is the difference in level between the top of the serviced apartments with Miami style green roofs and the level of the roadway at Area 1, (call this H) = 27.0 m AHD +3.0 m – 19.0 m AHD = 11 m. The distance from the windward roof edge near the centre of the serviced apartments to the memorial stone bench in Area 1, (call this D) = 122 m - as measured on Google Earth. This gives $D/H = 122/11 = 11$. The warriapendi website states that for a windbreak, D/H should be at least =10, and the area protected is generally up to D/H = 15 to 20. **This indicates that the subject buildings will significantly affect the air quality for Area 1 by obstructing sea breezes.** (As they will also for Audit House and Burnett House.)

Area 2: The physical escarpment between the existing fence down to the north boundary of the "Escarpment" as defined in the covenant plan:

This area relates firstly to the "NT EPA Environmental factors and objectives" under the Theme "Land", the Factor "Terrestrial ecosystems" with the objective "Protect terrestrial habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning"

The density and height of the vegetation on Area 2 is important to the proponent because Clouston Associates in their 2021 "Visual Impact Study" (CA 2021) decided that there was no adverse impact on the views on the Myilly Heritage Precinct (and hence on Area 1) because the density of the existing vegetation on the escarpment was already such that there were no views available anyway. CA 2021 went on to advocate "further screen planting and management of the escarpment vegetation to establish a dense screen to approximately 5m high", and "retaining and protecting the escarpment vegetation as this creates an effective screen". The above conclusions were also accepted by Silvano Jung in his "Heritage Impact Assessment: Myilly Point Precinct" (Jung 2021).

The problem with those conclusions in CA 2021 and Jung 2021 is that they assume that the current extent and density of the vegetation along the escarpment is natural and that therefore it is desirable that it become further thickened and become permanent. But apart from three trees near the top of the escarpment, all of the existing vegetation started from basically bare, rocky ground when the escarpment was “rehabilitated” in 2010. (See the 2010 aerial photo in Appendix C herein.) Subsequent aerial photos show that the area did not appear to get much regrowth until about 2015.

My own observations of the embankment in this area are that there are significant outflows of ground water occurring at the end of the dry season and these are probably generated by over-zealous dry season watering in the gardens above, or possibly by leaks in the piping above. (See Fig. B10 in Appendix B). I suspect that it is this unnatural ground water flow that has led to the current dense vegetation “screening” which the consultants regard as being desirable, but I regard as being, in the most part, lush and un-natural. (Refer Figs. B8 & B9 in Appendix B.)

The vegetation is certainly of a different density and quality to what it was in the past, and how it is now under the unwatered, western section of Lot 7078 (east of the Paspaley residence on Lot 5496). For comparisons refer to Figs. B1 & B2 and Figs. B11& B12 in Appendix B. Refer also to the historic aerial photographs showing the changes in the escarpment vegetation in Appendix C.

Hopefully the NT EPA will engage professionals who can recommend native species for the escarpment vegetation that are suited to the natural, dry season conditions, and that will enhance the natural beauty of the escarpment rather than accept vegetation that simply acts to screen out views.

Area 2 also relates to the “NT EPA Environmental factors and objectives” under the Theme “People”, with the objective “Protect sacred sites, culture and heritage.”

Aboriginal kaolin mine adits in the embankment below Area 1: After the vegetation on the embankment was cleared for rehabilitation in 2010 (shown in Fig. C4 of Appendix C), I noticed a hole in the cliff face below Area 1 that I had never noticed before. On close inspection it had obviously been made by Aboriginal people doing what they have probably been doing in this area for thousands of years – digging to obtain good quality kaolin. The adit was about 1.5 m diameter at the entrance, and from memory, extended about 2 m into the cliff face. Aboriginal women are still mining kaolin from the cliffs below the Nightcliff Swimming Pool. I have been told that it is used now as body paint for their dead, and as a medicine to give babies strong bones. The kaolin mine that I saw at Little Mindill (and there will be others) would have probably also been used for corroboree body paint decoration.

To give a little more importance to this mine and its relationship with Darwin history and culture, I conclude this section with my explanation as to how we came to have the unique-to-Darwin locality name Kahlin and its probable connection with kaolin.

The initial name, “Kalin”, first appeared in print in a caption to a photograph that was appended to Baldwin Spencer’s 1912 report which recommended the establishment of the Kahlin Compound. But Spencer never used the names Kalin or Kahlin and was probably not even aware that the photographer had appended the name to his report. The photographer was James Pinkerton Campbell (1865-1935). His image of “Kalin” was taken from Emery Point.

Now this part is only my conjecture, but Campbell probably got the name by asking an Aboriginal person who lived there what the locality was called, and the Aboriginal people got the name from the Chinese market gardeners who were also established there. These gardeners would have recognised that the kaolin the Aboriginal people were using for body paint was the same kaolin that their ancestors had been using for hundreds of years to make their famous pottery, and the Aboriginal people were happy to adopt that originally Chinese name for the area – at least for its use by a white man. So, the name Kahlin went from the Chinese pronunciation of kaolin, to the Aboriginal pronunciation which perhaps sounded more like karlin, to Campbell who wrote it down as Kalin. The name next appeared in print with the newspaper report of the opening of the compound a year later. It was attended by many church dignitaries and at least one of them would have known that Kalin is the name of a Hindu god – hence the “h” came to be added.

Regardless of the origin of the name, those mines in the embankment need to be protected as important historical objects and possibly, if Aboriginal people see fit, as sacred sites.

Concluding remarks for Areas 1 & 2. This is beyond the scope of this submission, but it needs to be mentioned: namely that the proponents would overcome a lot of community concerns about Area 1 and Area 2 if they arranged to excise the “Escarpment” from Lot 7651 and have it rezoned from Zone TC to Zone PS as was done for the Little Mindil Creek area and approved by DIPL in May 2021. This has enabled the creek area to come under public rather than private management. Something that would also benefit the Escarpment.

Area 3: The remaining area of Lot 7651: This section will deal only with the serious risk of a tropical cyclone generated surge plus wave runup impacting the seafront villas. The storm tide level could be 2 to 3 m above the proposed floor levels, with waves smashing into the seafront villas so that they would be totally or partially destroyed. The environmental impact of concern is that this significant variation in the villas would block the inward, surge flow which would then be concentrated as high velocity flows around each end of the villa rubble and scour out areas within the Little Mindil Creek area and along the base of the escarpment and the Power & Water switchyard near Nurses Walk.

This “significant variation” relates to the “**NT EPA Environmental factors and objectives**” under the Theme “Land” with the objective to “Conserve the variety and integrity of distinctive physical landforms”. It also relates to the Theme “People” with the objective to “Protect sacred sites, culture and heritage” – there is a sacred site within the creek that would be threatened by the scouring.

To properly examine the risks and consequences of such an event would take many pages and this submission is already too long. For readers who are interested in what can be learned from the historic records relating to cyclones, surges and their risks, Appendix D has an edited version of my submission to Development Assessment Services, DIPL relating to the risks and impacts of Storm Surge from Cyclones, for the NT Planning Scheme and the Little Mindil development .

Mike Nicholls, Rapid Creek, 2 Nov 2021.

References:

Cook, G. D. and M. J. Nicholls. 2009. Estimation of tropical cyclone wind hazard for Darwin: comparison to two other locations and the Australian wind loading code. *J. Appl. Meteor. Climatol.* **48**: 2331 –2340. <https://doi.org/10.1175/2009JAMC2013.1>

Harper, B. A., J. D. Holmes, J. D. Kepert, L. M. Mason and P. J. Vickery. 2012. Comments on "Estimation of tropical cyclone wind hazard for Darwin: comparison with two other locations and the Australian Wind-Loading Code". *J. Appl. Meteor. Climatol.* **51**: 161 – 171. <https://doi.org/10.1175/JAMC-D-10-05011.1>

Cook, G. D. and M. Nicholls. 2012. Reply (to Harper et al.) *J. Appl. Meteor. Climatol.* **51**: 172 – 181. <https://doi.org/10.1175/JAMC-D-11-059.1>

APPENDIX A

The clause of the 2009 covenant relating to the rehabilitation and regeneration of the Tidal Creek and the Escarpment. (The exact locations for these two places were shown shaded and hatched respectively on the “Plan” which was on page 11 of the contract document)

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2. COVENANTS BY THE OWNER

- a) The owner must at its own cost and to a standard reasonably required by the Territory:
 - (i) rehabilitate the Tidal Creek and the Escarpment within twelve (12) months of the date of registration of this Covenant;
 - (ii) preserve and maintain the Tidal Creek and the Escarpment.
 - b) Without limiting the covenant contained within clause a) the Owner must at all times:
 - (i) provide continuing care of the vegetation on the Escarpment (including the top and base of the Escarpment) and the Tidal Creek including:
 - (1) removal of noxious weeds and subsequent control of noxious weeds using chemical or physical means or a combination of them,
 - (2) removal of litter, rubbish, and foreign objects; and
 - (3) revegetation with naturally occurring plant species,based on best practice bush regeneration techniques;
 - (ii) as required from time to time:
 - (1) mulch and replant/reseed vegetation; and
 - (2) repair and replace fencing along the top of the Escarpment to a standard to match the existing fencing.
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APPENDIX B

Selected photos of the localities having relevance to this submission - all photos were taken 19/10/21:



Fig. B1 The sea view across to East Point that is available from the escarpment along the western (and un-watered) end of Lot 7078. (On the western end of Myilly Point, east of the Paspaley residence.) Similar views were once available from Area 1.



Fig. B2 View to the north through one of the few breaks in the dense vegetation from the fence at Area 1.



Fig. B3 Same view as Fig. B2 but after climbing over the fence and getting to the edge of the escarpment. White building at centre is a temporary entertainment pavilion in the SW corner of the Casino grounds.



Fig. B4 Fence corner post is “Point Y” at the east end of the southern boundary to Lot 7651



Fig. B5 View west along the “Escarpment” boundary = southern boundary of Lot 7651. The boundary line passes just to the right of the power pole. **Area 1 is to the right of this line.** (It would be good if that ugly power line could be put underground – but that is for another day.)



Fig. B6 View to the east down Burnett Place. NW corner of the Audit House lot is near the pole on the right. The western end of the straight, E-W “Escarpment” boundary is near the stone memorial seat opposite the pink sign. The white car in Fig. B5 is just visible right of centre frame.



Fig. B7 Plaque on memorial seat in Fig B6



Fig. B8 An old sign placed by the Myilly Land Care Group. Vegetation behind is typical of the “drier” vegetation that is growing on top of the escarpment at its east end. Note that the fence here is part of the 50 m length of fence that actually is on the “Escarpment” boundary.

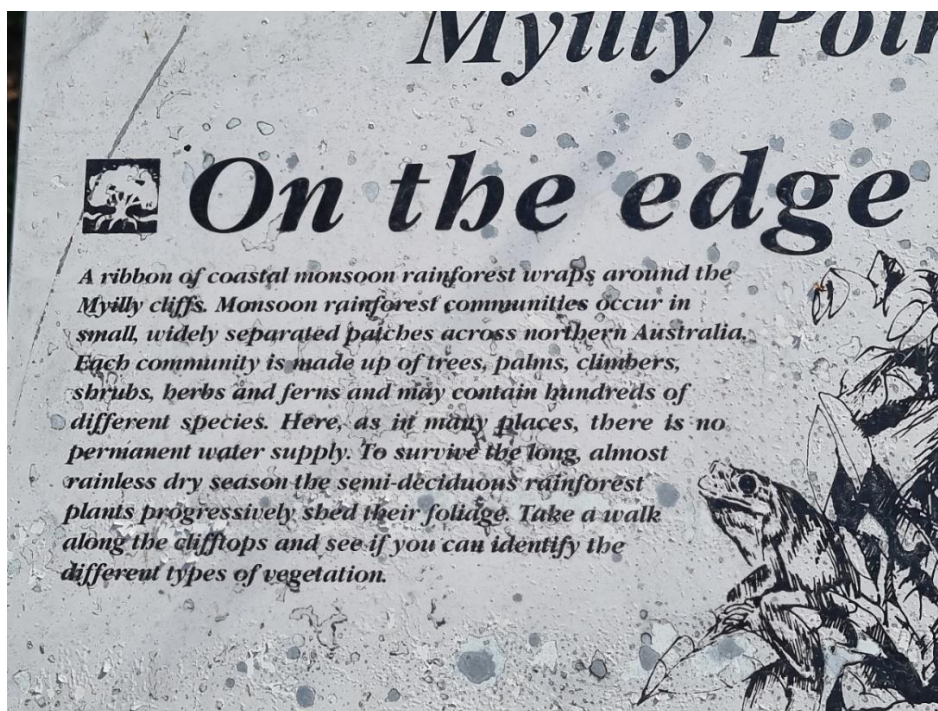


Fig. B9 Note the sentences: “Here, as in many places, there is no permanent water supply. To survive the long, almost rainless dry season the semi-deciduous rainforest plants progressively shed their foliage.” MN: It is apparent that these days, during the dry, much of the escarpment further west receives ground water from garden sprinkler irrigation, or leaking pipes, on the plateau above.



Fig. B 10 Looking up to the top of the escarpment below the mid-point of Area 1 (after having first penetrated the dense vegetation growing at the base of the escarpment shown in Fig. B 11.) Note the ferns growing at the end of the dry season – indicating that they are getting ground water originating from garden sprinklers or leaking pipes above.



Fig. B 11 Vegetation along the base of the escarpment below Area 1. Note how it completely obliterates the view of the magnificent rocky escarpment from below and the views from Area 1 above.



Fig. B 12 Judicious clearing of escarpment vegetation below the Myilly Cliffs apartments.

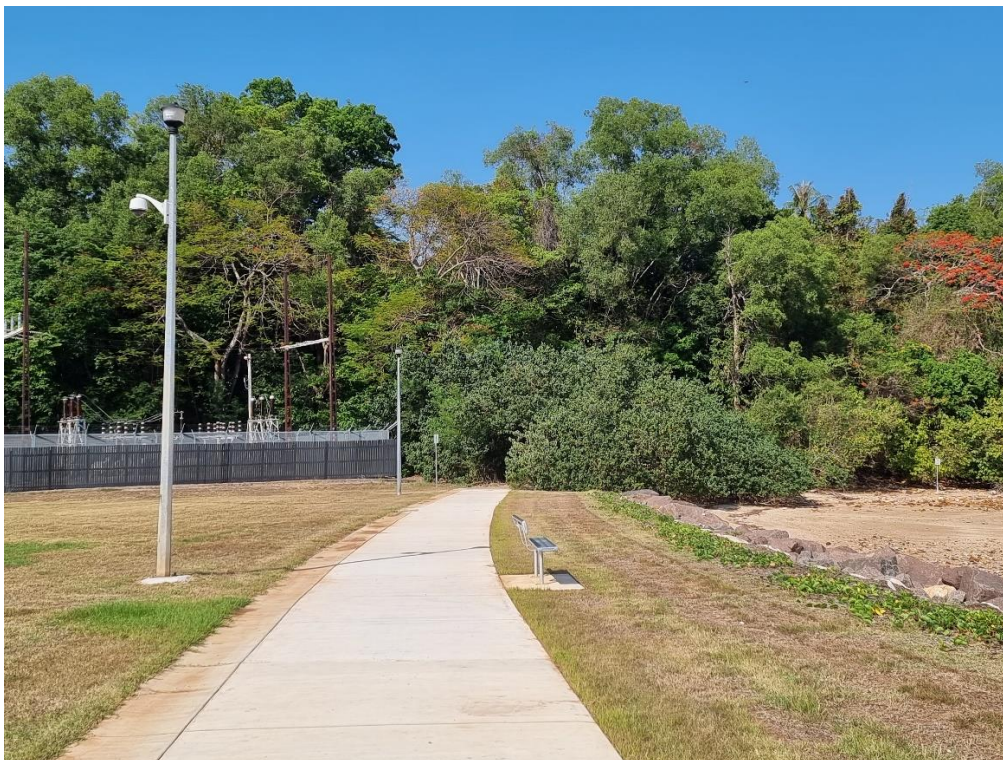


Fig. B 13 New rock revetment and foreshore path looking south toward Nurses Walk. The path appears to be at about 4.0 m AHD. (*This is an important level to remember when reading Appendix D.*)

Questions: Is the western boundary of Lot 7651 to the east of the nearest light pole.? If so, how far east ?



Fig. B 14 Vegetation along the escarpment below the western, un-watered end of Lot 7078. Much of this vegetation, such as the poinciana, will be garden escapees rather than native. But it is this sort of density which I consider should be the aim for the escarpment below Area 1. Compare the view from above this figure's location in Fig. B1 with the best view available from Area 1 shown in Fig. B2.

Mike Nicholls, Rapid Creek 2 Nov 2021

Aerial Views of Little Mindil site including the escarpment

Fig C2, 1975 aerial photo. Taken soon after Cyclone Tracy. The escarpment is stripped bare.



Fig. C3, 2008 aerial photo. 33 years after Tracy but less vegetation on escarpment than now.



Fig. C4 2010 aerial photo. Showing escarpment stripped nearly bare following “rehabilitation” under the 2010 covenant



Fig C5. 2015 aerial photo. Note rapid growth of trees along base of escarpment but vegetation along top of escarpment was still enabling some sea views.



Fig. C6. 2020 from Google Earth Pro Embankment vegetation in 2021 is even more dense – almost completely obstructing views from Area 1.

APPENDIX D

The following is a revised and edited version of part of the writer's submission to the NT Governments' Development Assessment Services branch on 21 Oct 2021 in relation to the following title:

Objection to a proposal to amend the NT Planning Scheme_ PA2021/0297 known as the Little Mindil proposal, Lot 7651, Darwin NT

Nature of Objection: Development is contrary to the provisions of the NT Planning Scheme relating to storm surge from cyclones.

MN Note: The following is the part of the submission dealing with surge and cyclones rather than provisions in the NTPS..... ADG made a request about "Storm Surge Level" for the site from the Surface Water group in DENR who then *"carried out a desktop study on storm surge level (and flooding levels) based on available (published) relevant Mappings such as Storm Surge Flood Mappings and digital data as GIS layer."* The DENR information was presented to ADG in a table of "Primary Storm Surge Level" and "Secondary Storm Surge Level" for six points around the site. There was not much variation within each group with the average levels being 5.5m AHD for the PSS and 5.8m AHD for the SSS. Interestingly, this statement (also in red) was appended to the DENR table: *"This document contains information obtained through a desktop assessment. DENR has made every reasonable effort to provide current and accurate information, but it does not make any guarantees regarding the accuracy or completeness of the information. The information in this document does not constitute professional advice and should not be relied upon. You should obtain your own professional advice"*

It appears that ADG did not obtain professional advice because they seem to have fallen into a common trap and regarded the levels given to them as maximums rather than minimums. They also seem to think that provided a site is raised using fill up to the PSS level plus 0.3 m "freeboard" (as one does in a riverine flood plain), then that will demonstrate that "there is no increased risk to people and property, including adjoining property".

ADG display this logic in their one and only paragraph devoted to storm surge. It is on page 9 of their Engineering Services Report where it is hidden away under the heading "Bulk Earthworks" where they recommend a minimum floor level of 5.8 m AHD. Since then, someone has increased that minimum floor levels to 6.0 m AHD and the fill is to be placed up to 5.8 m AHD.

What is wrong with what the applicants have done ?

Firstly, they should have looked closely at the side text on the "Darwin Area Storm Surge Inundation for 2100" map and seen this one line out of about 30 which says, **"The extents do not include the possible effects of very localised wave runup"** To give an example of what "wave runup" means, imagine a TC is raging, the storm surge levels are increasing, and the sea water is already as high as 5.8 m AHD. The natural surface level of the beach at a point about 30 m out from the wall in front of the seven waterfront villas is about 2 m AHD. With 250 kph winds causing huge seas with waves as high as 8 m offshore, only the smaller waves will make it into that that point before they start to break onto the existing, new rock revetment adjacent the public footpath and then on against the

seven villa walls. Those waves would be more than 3 m high with the wave tops just offshore at above 7.3 m AHD. This is where wave runup comes in because that wave energy as well as trying to destroy everything in its way, also leads to an increase in sea level which is known as “wave runup”. **It is known that the wave runup at Casuarina beach from TC Tracy was about 2 m, as was the wave runup at the north end of Fannie Bay during the 1937 cyclone.** It would only take the narrow passages at each end of the seven villas to become partially, and then fully blocked by the huge volume of debris that the wind and the waves would have generated, for the surge + wave runup level at and behind the seven villas to become $5.8 + 2.0 = 7.8 \text{ m AHD}$.

Secondly, they should have realised that usually TCs bring very heavy rains, and these commonly coincide with surge events. Adding flood events to the surge levels is not suggested in the Darwin surge map but most engineers know it needs to be considered. Doing that roughly here - the catchment area for the Little Mindill Creek has an area of about 1.1 km² and the ponding area on the flats below has an area of about 0.15 km². (The Little Mindill culverts and low bridges will almost certainly have become blocked with debris.) If it is assumed that there is 150 mm/hr rain over one hour corresponding with the surge inflow, the rain flooding would increase the surge levels by about 0.6 m. **This brings the combined surge + wave runup + rain flooding level to $7.8 + 0.6 = 8.4 \text{ m AHD}$. This is about one storey higher than the nominal “ground floor level” that the applicants have allowed for. (And two storeys higher than the basement floor levels to the 7-storey hotel blocks.)**

Learning from Historic Darwin Cyclones. As mentioned above, the wave runup from the 1937 cyclone and from Cyclone Tracy (1974) was observed to be about 2 m at the north end of Fannie Bay and at Casuarina Beach respectively. But neither of these cyclones created a significant storm tide. The 1937 surge coincided with a low tide. Tracy’s surge did coincide with a high tide, but they were only neap tides at the time.

But there is one cyclone in our history whose effects did nearly coincide with a high spring tide. That was the **March 1919 cyclone** that devastated the then-named Bathurst Island Mission with a surge + wave runup of more than 4 m. It was probably at least a Cat. 4 cyclone but what is especially significant is that it tracked across Beagle Gulf in a **NE** direction. It started near Wyndham on about 2nd March, heading north then curving around eastward into Beagle Gulf so that it passed about 50 km to the north of Darwin and about 30 km south of the mission early on 6th March. It continued tracking eastward and ended up in the Gulf of Carpentaria where it nearly wrecked the coastal steamer *Sir John Forrest* which was returning to Darwin from Borroloola¹. Because it passed so far north of us and it was in the early hours, most Darwin people only experienced gales and heavy rain during the night. But because of its direction and intensity this cyclone swept huge waves into Beagle Gulf from the Timor Sea and then on round (clockwise) down to Darwin where those waves generated a very high surge. That surge nearly coincided with a very high spring tide which would have been disastrous, but the two events were close enough to generate **by far the highest storm tide in our recorded history**. Sailors and seamen of course knew about the surge in Darwin that night, several boats were sunk or washed ashore and part of the government jetty at Stokes Hill was washed away.

The largest boat to wash ashore was the **76 long**, coal hulk Warrego which washed ashore in Francis Bay with 600 tons of coal aboard. The remains of the Warrego are still where she washed ashore, now buried beneath fill, but her steel bottom plates will be intact with the bow only about 15 m seaward from the NFI Oil Tank No. 3.



Fig. 1 Warrego in the 1930s. Bow near Tank 3. Looking SW with the old Fort Hill in background.

I have carefully analyzed the many photographs and known dimensions of the Warrego and estimate that the storm tide level which washed her ashore was equivalent to a level of **5.4 m AHD²**. Because Francis Bay is comparatively sheltered, the waves would not have been high and so there is no wave runup included in that level. This means the level directly relates to the “5.4” level shown near the Warrego site in *Fig 4.7 Darwin 2010 10,000y Scenario Storm Tide Inundation m AHD* from the “High Resolution Storm Tide and Climate Change Impacts Study -2010 ” by SEA Pty Ltd.

There is only a 1% chance that a 1 in 10,000 year storm surge could have hit us within the last 102 years. A more likely explanation, founded also on other evidence, is that the SEA Pty Ltd study (and consequently Darwin’s current storm tide map which is based on that study), seriously under-estimates surge risks.

The maximum observed storm tide level for the 1919 cyclone was 8.4 m AHD:

I interviewed a well-known Darwin identity, Jack Haritos, in about 2005 wanting to ask him what he could remember of the 1937 cyclone. He could not remember much about it, but then he said, “But my father used to tell us that when the Warrego washed ashore **Darwin became an Island**”. Jack’s father was Eustratios Haritos who in 1919, with one or two partners, constructed a commercial salt pan alongside the Ludmilla Creek (near where Spot On Marine is now). Evidently Eustratios, or one of his partners, followed the debris line up stream until he saw that the sea had crossed over Freds Pass Road at the Narrows, then flowed down under the still-existing railway bridge, and on down into Sadgroves Ck and Francis Bay. Jack was intent on telling me that his father was a serious, well-read man who would never make up a story like that. The levels at the “saddle” crossing place in Dwyer Park are still much as they would have been back then – hence it is an easy matter to take some levels in the field to find that the **storm tide level at the Narrows saddle was 8.4 m AHD.**

There are several reasons why the storm tide could have been 3 m higher at the Narrows than it was where the Warrego washed up. For the “Narrows” case, there also would not have been much wave runup, but here, rather than the location being sheltered from wave action, it was because there were no steep beach slopes, high dunes, or structures for the high waves to break against. However, the exposed, wide, shallow bay offshore would have led to much higher **wave setup**³ than could have occurred in Francis Bay. Also, the incoming wind and surge would have been moving directly in the creek’s upstream direction causing the storm tide level to be amplified as it was forced up the ever-narrowing and shallowing Ludmilla Creek. Finally, the catchment area of the upper reaches of the creek down to Dick Ward Drive is 5 km² so there could have been at least 0.5 m of rain flood contributing to the 8.4 m AHD storm tide⁴.

Conclusions: The applicant has either misunderstood or ignored the intent and purpose of the NTPS provisions in Section 3.7 Land Subject to Storm Surge. His efforts to circumvent those provisions indicate that he does not understand the real and present danger from cyclones and storm surge. His efforts, if successful would present a mortal danger to those who occupied the buildings if they stayed in them or if they did not, would mean extra people seeking shelter in our already less than adequate capacity cyclone shelters.

The development application should be rejected on many grounds including the non-compliance with NTPS Section 3.7 LSSS. Darwin already has too many high density dwelling within the PSSA and the SSSA – we do not need any more.

Mike Nicholls, Rapid Creek, Dated: 2/11/2021

Endnotes:

1. Refer pages 22 to 25, of Big Blow Up North by Kevin Murphy. (BoM staff member in Darwin in the 1980s.)
2. That **5.4 m AHD** level at the Warrego site equates to a **2100** level at Little Mindill of **7.1 m AHD**. Refer *Fig. 4.7 Darwin 2010 10,000y Scenario...* and *Fig D-3 Darwin 2100 10,000y Scenario...* in the “High Resolution Storm Tide and Climate Change Impacts Study-2010” by SEA Pty Ltd. This is one of the three reports which forms the basis for the NT Government’s current “Darwin Area Storm Surge Inundation for 2100” map. (Note that the 7.1 m AHD does not include for wave runup or rain flooding.)
3. Unlike wave runup, the effects of **wave setup** are included in the term “surge” and in the storm surge inundation levels as defined on mapping produced by the NT Government. To explain the two terms a little, wave setup results from the shoreward energy produced by waves breaking offshore and nearshore, whereas wave runup results from the shoreward energy of waves breaking onshore.
4. This is very late to give more precise definitions – but better late than never. A “storm tide” is simply the level obtained when a “surge” height is added to the astronomic tide level that happened to exist at the time. It is a “level”, so it is expressed relative to some fixed datum – usually “AHD”. (AHD stands for Australian Height Datum which was adopted to be the mean sea level (MSL) measured at 30 tide gauges around the coast of Australia in 1966-68.) The word “surge” is used very loosely when applied to the result of a tropical cyclone – it is sometimes used instead of storm tide, sometimes used to include wave runup and sometimes, and correctly, used to exclude wave runup but includes wave setup plus surge, where this surge is correctly defined as the increase in sea levels near a coastline resulting from a cyclone’s reduced barometric pressure and the effect of offshore winds blowing against the sea surface towards the coastline – it is measured in m rather than m AHD. Where it really gets confusing is that the MSL is rising, and the current government surge map is for conditions in the year 2100 when the MSL is assumed to be 0.8 m higher than it was in 2010. (Tidal ranges will not vary much in time and, because tide levels are given in terms of “chart datum” (Lowest Astronomic Tide), they will remain invariant.)