# SAIBAI

## UNDERSTANDING CLIMATE CHANGE DRIVEN COASTAL EROSION AND INUNDATION IMPACTS ON TORRES STRAIT COMMUNITIES AND THE DEVELOPMENT OF ADAPTATION OPTIONS

*Prepared for:*
Department of Climate Change and Energy Efficiency
Commonwealth of Australia
&
Saibai Community

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Funded by the Australian Government represented by the Department of Climate Change and Energy Efficiency

## 1. Introduction

This report to the Saibai community talks about the work we have been doing since the end of 2010 on erosion and inundation (flooding at high tides and during storms). We know that there are problems with erosion and inundation on Saibai, and throughout Torres Strait. Some communities are worse affected than others, and Saibai is without doubt one of these. We also know that there is a good chance that some of the problems will get worse in the future if the climate changes. The sorts of things that might affect the communities of Torres Strait are higher sea levels and more intense storms. The work we have been doing is being funded by the Department of Climate Change and Energy Efficiency, a Commonwealth Government department, and we have been working with the Land and Sea Management Unit of TSRA and a number of other organisations trying to achieve outcomes that put Torres Strait communities amongst the best prepared in Australia to deal with future climate change.

Our research methods and other details of the overall project are in a separate summary report. The summary report (which is quite big) has been sent to the Council, the Rangers and the PBC.

Our work on Saibai and Boigu is very much different to the work we have done for the other island communities. A lot of good work has been done previously to understand the problems that the communities already have, and the effects of future climate change. In most communities, our job has been to do work to understand the long term and short term coastal processes that lead to coastal erosion, and to come up with options to put to the community. We also discuss inundation (flooding by the sea) on the high tides, and provide some information based on a LIDAR survey about which areas are likely to be covered by water at high tide and on storm tides, and what might happen if sea level rises. This has meant that we have visited the communities a number of times. For Saibai, there was no need to do the same sort of work as we already know the problem, and have some idea of the ways forward. We did not want to waste your time by doing the same work that others have done, and come to the same conclusions, so for Saibai and Boigu we do something different, and that is reported here.

We have not visited the community so far as part of this work. Unfortunately, there were various obstacles every time we tried to come, including the accommodation being full, and the people we wanted to see being unavailable at times that we could come. We have talked to various people from Saibai and we would like to thank Councillor Ron Enosa and the PBC (represented to us by Eddie Sam) for supporting our work. Fortunately we could do our work without coming to Saibai, and in the end we decided that it was best to write the report, and spend more time with you discussing the outcomes after you have had time to read it. So you will be seeing us over the next few months, to talk through the options and hopefully develop a plan.

Over the years, erosion has been addressed by the construction of seawalls (and these are in need of repair and rebuilding). There are reports that TSRA commissioned that design and cost building of new of seawalls, written by AECOM (2012). You will also know that various funding applications to do the work have been made. A properly constructed seawall will stop erosion.

The unfortunate fact is that Saibai is very low, and because of that is at risk of inundation, with sea levels as they are right now. If sea level rises, the problem will get much worse. The options available for Saibai are very few, and in the longer term may come down to two quite drastic possibilities. The first is leaving the island and rebuilding the community elsewhere. The second is what we call “fortification and elevation”, and that involves making the island higher and making sure it doesn’t erode using walls.

The object of this report is to investigate two adaptation options for the long term. This does not alter in any way the need to proceed with immediate protection works as detailed in the report by AECOM (2011) *Inundation Management on Saibai, Boigu and Iama Islands*, a report prepared for the TSRA. We investigate the monetary cost of the assets that would need to be rebuilt at some other Torres Strait location should the community need to relocate, and we investigate the cost of elevating (raising the land level) of the community. Both these options would result in very significant disruption to the community, but they must be investigated and considered.

Please be very aware that we are not suggesting that people should leave the community. We very much understand the long history, rich culture and very long association with your home, and you have made it very clear that you want to stay on Saibai. Our job is to provide as much information as possible for you to make informed decisions, and to help your leaders take your messages to government. Without the sort of information provided in this report, questions will always remain about the possibility of elevating the island or relocating. Our job is to provide the information on which decisions, one way or the other, can be made. What is clear is that some time in the near future, decisions will have to be made, and we hope this information can support that decision making.

Everybody knows that it is very difficult to get the money to get things done. There has been a lot of talk in the news about how hard it has been to get money to fix some of the problems in the communities that have some of the worst erosion and inundation problems (such as Saibai). However, the work that we did in the past for Masig, Poruma, Warraber and Iama and that others did for Saibai and Boigu has meant that we are well prepared to take advantage of any opportunity that comes up. Although it may not always be obvious, based on the work that has happened in these communities already, and the fact that there are Coastal Management Plans that write down what the community have agreed, progress has been made. There are now detailed costings for some works, and a number of things that don’t cost a lot of money have already happened. For Saibai, our work reported here adds to the body of information that must be gathered for applications to governments to be successful. This is part of a process that we understand is long and frustrating for you. We hope that you will read over this report, be ready to ask us questions when we visit (or by phone or email), talk to others in your community, and help us come up with a plan that we can then try to make happen!

## 2. Saibai

Saibai is a community of approximately 370 people (based on the 2006 census) (SLUP, 2010) approximately 6 km from the Papua New Guinea mainland (Figure 2.1). Saibai Island is a flat mud island, approximately 22km long by 7km wide. The village (Figures 2.2 to 2.4) is located on the northwest shore. Saibai has been formed by an accumulation of mud and silt deposited on old coral platforms.

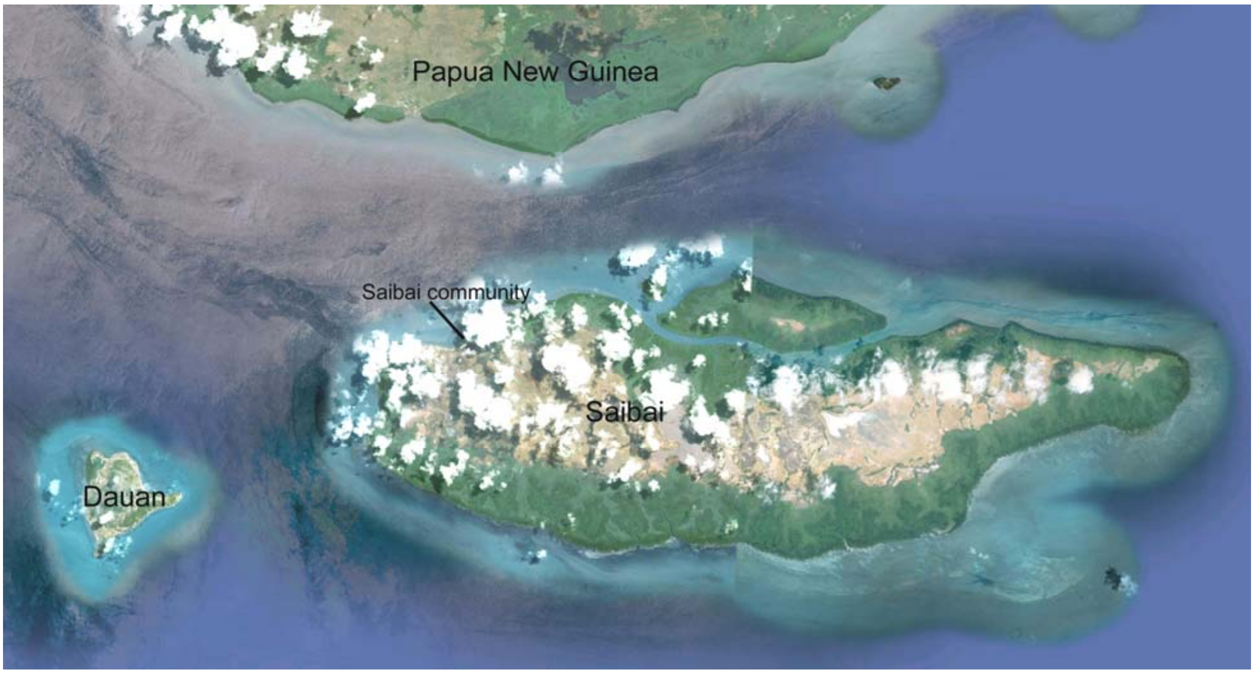


**Figure 2.1:** Saibai community faces northwest, and is protected from the southeast winds, and to some degree from the north by the Papua New Guinea mainland and relatively shallow water.

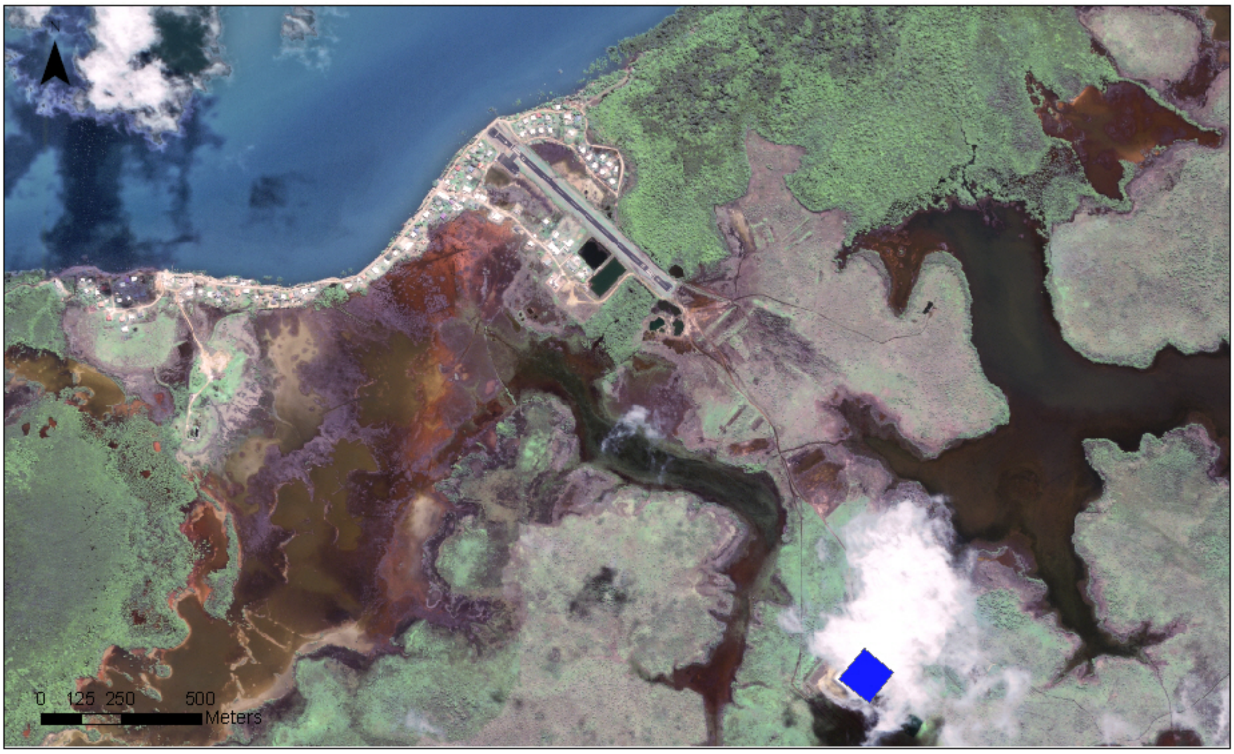


**Figure 2.2:** Saibai community including the water storage (under cloud, highlighted in blue).


**Figure 2.3:** Saibai community.

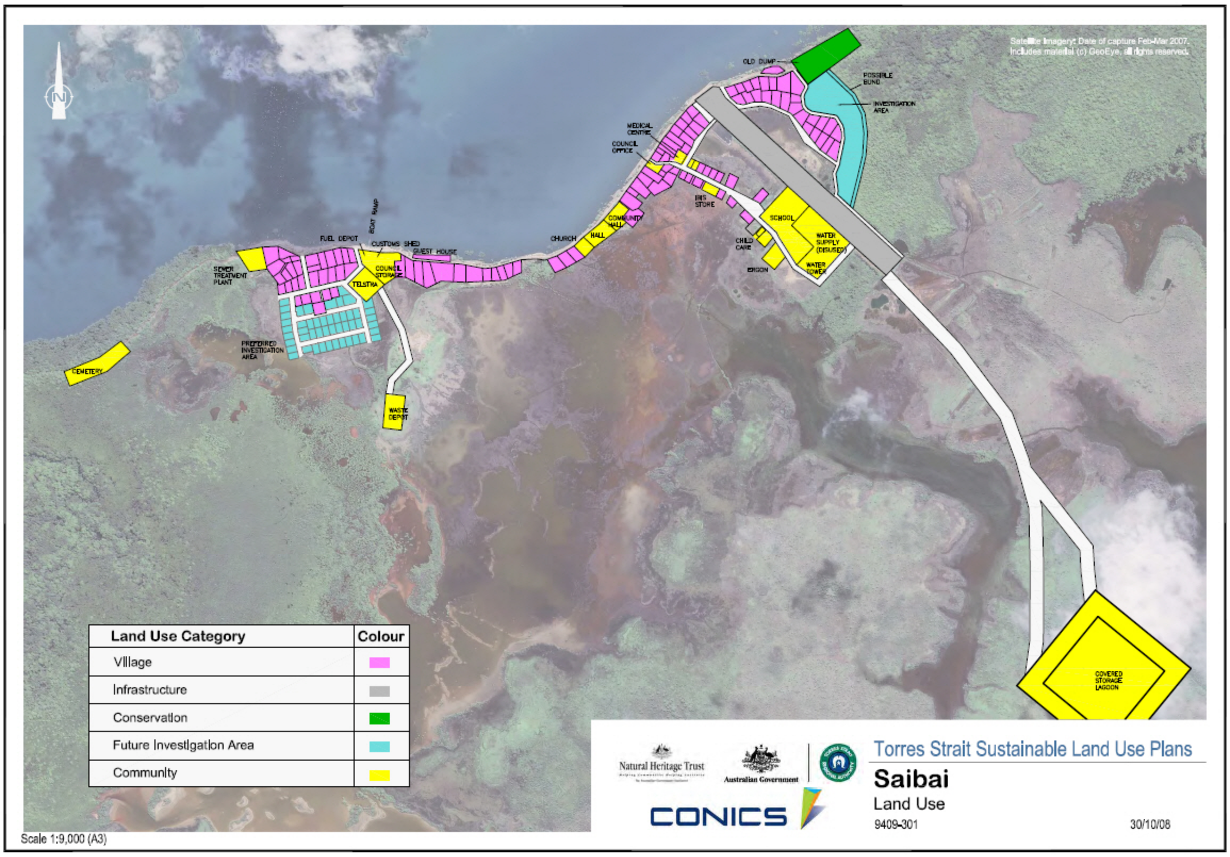


**Figure 2.4:** Saibai land use (SLUP, 2010)

## 3. Research methods

*Asset Replacement*

We are not experts in asset valuation or construction, and in order to get an accurate opinion on the cost to replace the existing assets in the community at a different location, we engaged Black & More to identify the existing assets on Saibai and Boigu, and provide an Opinion of Probable Construction Cost (OPCC) to replace existing assets in the current construction market. Black & More have extensive experience in the Torres Strait area, having managed the Major Infrastructure Programme over a number of years. A copy of the *Asset Replacement Report* is attached to this report.

*Elevation of the community*

In order to estimate the cost of elevation of the ground surface on Saibai to protect it from inundation we asked Black & More for a probable cost of purchasing and transporting select fill to Saibai and Boigu from Cairns. This information is found in the attached *Asset Replacement Report*. We then used LIDAR height elevation data, provided by DERM to work out how much fill would be required in order to raise the level of the community, or parts of it. Clearly, there would be a range of extra costs associated with elevating the land surface (such as landscaping, rebuilding roads and elevating buildings), and we make some comment on these.

The use of LIDAR was made problematic by the fact that it was captured prior to a Spatial Infrastructure Audit, which used tide gauge data to try to establish accurate heights in relation to sea level for all the Torres Strait communities. The *Spatial Infrastructure Audit* was completed in 2011. The LIDAR data, which provides extremely accurate height information at very high spatial resolution, was based on a height datum that was clearly, and known to be, inaccurate. We compared a number of heights of benchmarks (PSMs) which matched the height data used in the LIDAR study (kindly supplied by Ian Doust of RPS Group), to the heights of the same benchmarks as reported in the *Spatial Infrastructure Audit*. This resulted in a datum shift of -0.71m. The points we used are shown in Table 3.1. We then applied this height shift to the LIDAR data. From the LIDAR data we then built a TIN model, and then calculated the volumes of fill required to elevate parts of the community to different levels. TINs (Triangulated Irregular Networks) are 3-dimentional surfaces calculated from the LIDAR survey data.

**Table 3.1:** Data used to establish a height datum shift for LIDAR analysis.

| PSM | LIDAR height(m) | Spatial Infrastructure Audit height (m) | Difference |
|---|---|---|---|
| 173502 | 3.353 | 2.641 | -0.712 |
| 173503 | 2.264 | 1.552 | -0.712 |
| 177952 | 4.733 | 4.026 | -0.707 |
| 177956 | 3.010 | 2.295 | -0.710 |
| | | **AVERAGE** | **-0.710** |

## 4. Summary of other studies

Previous work undertaken by the Environmental Protection Agency (now DERM) in the form of the *Rapid assessment of shoreline erosion and management, Saibai Island* and by Angus Gordon, *Saibai coastal and infrastructure management, including seawall and village inundation*, was followed up recently by detailed costings for works, commissioned by TSRA, and prepared by AECOM in 2011. The report is quite comprehensive, but looks at the situation right now, based on current sea levels. These works are urgent and are needed because other options will take time to decide upon and implement. We support the efforts of TSRA, TSIRC and others to obtain funds to undertake these works.

For Saibai the AECOM report recommends:

- Replace the existing seawall with either a Seabee or rock seawall that incorporates a wave return wall with a crest height at 3.1m AHD. These works are estimated to cost approximately $11,000,000.

- Provide protection against inundation from the wetlands at the rear of the community by upgrading drainage and constructing a bund wall with a crest height at 2.5m AHD. These works will cost approximately $7,900,000.

- Construct a 1m high reinforced concrete wave return wall around the Cemetery to improve inundation immunity at a cost of approximately $590,000.

These costings are based on the current sea level. Our report attempts to look at what might happen with increased sea levels.

## 5. Inundation analysis

The inundation analysis shows areas that are likely to be flooded under different circumstances (scenarios) in the future. It is important to remember that the areas identified are not going to be under water continuously – only at times of the very highest tides, and for a few hours at the most. However, with sea level rise, the situation is only going to get worse.

Figure 5.1 shows the TIN model for the village that was constructed from the LIDAR data. From the TIN model, sets of diagrams were produced. They plot different levels (like filling up a bathtub with different amounts of water) that came from a report by Systems Engineering Australia, where they looked at the likely water heights for different storm conditions and at different sea levels that may occur in the future. The different conditions that we plot are listed in Table 5.1.

It may seen strange that the storm tide levels of flooding for the 100 year and 1000 year return periods are not too much higher than for HAT (Highest Astronomical Tide) right now. To understand why this is, we need to know what the terms 100 year and 1000 year return periods actually mean.

Firstly a storm tide is the level of the water, above the expected, caused by surge events and wave setup (something that happens when there are big waves) referenced to MSL (Mean Sea Level). It does not include the wave runup that can also happen. Figure 5.2 gives a definition of some of the terms that are used. A 100 year return period is a set of conditions that happen on average, every hundred years, or in other words, have a 1% (1 in 100) chance of happening in any given year – that is this year, next year, the year after and so on. To calculate the levels plotted, the tide level and the storm tide level are combined. Because the tide is only very high sometimes, and then only for a few hours, the chance of a storm tide happening at the highest of the high tides is actually quite small. That means that the return periods seem to be very large.

We then have to consider sea-level rise. The Queensland State Government suggests that we should be planning for a 0.8m rise. The Commonwealth Government has suggested 1.1m. For most purposes, we should be planning for at least the 100 year return period. If we want to be extra safe, we can use a higher level like the 1000 year return period. For our summary, we suggest that any building within the 1000 year return period line, with 1.1m sea level rise, should, if at all possible, NOT be rebuilt in the same location once it gets old and needs replacing. The data below shows that this can not apply to Saibai without other drastic action.

The various different combinations of circumstances, plotted as 'bathtub' models, are shown in Figures 5.3 to 5.5. Each figure starts with the present day situation at the highest of the high tides (HAT), and then adds sea level rise only (Figure 5.3), the 100 year return period Storm Tide and sea-level rise (Figure 5.4), and the 1000 year return period Storm Tide and sea-level rise (Figure 5.5). These figures are plotted over a 2003 satellite image.

The data shows that at highest astronomical tide (and this tide only happens very occasionally) most of the community at ground level will be inundated (Figure 5.3a). With sea level rise of only 0.3m, almost all of the community is inundated. With 0.8m sea level rise and above, almost everything is underwater with the exception of the power station. Figure 5.4 looks at the situation with respect to storm tides. The 100 year storm tide is only a little higher than HAT for reasons discussed above. Figure 5.5 looks at the 1000 year return period storm tide. Clearly, the issue of inundation is very serious for Saibai, and this is very well known in the community.

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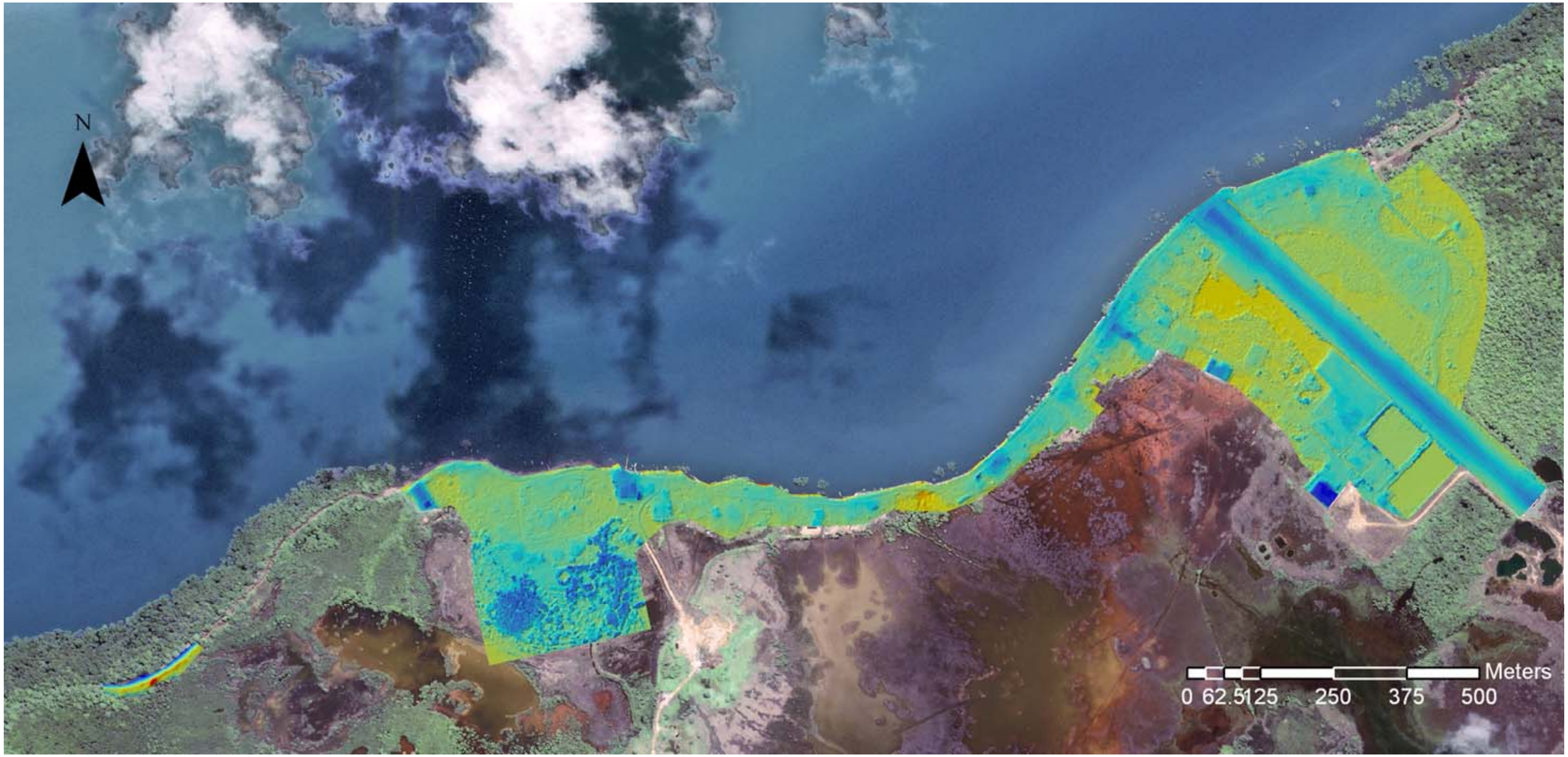


**Figure 5.1:** TIN model of the Saibai community.

**Table 5.1:** Saibai inundation levels used for "bathtub" inundation analysis.

| **Level (m) above MSL (0.0m)** | **Level (m)** |
|---|---|
| | |
| HAT | 2.17 |
| HAT+0.3m | 2.47 |
| HAT+0.5m | 2.67 |
| HAT+0.8m | 2.97 |
| HAT+1.1m | 3.27 |
| | |
| HAT | 2.17 |
| 100 year storm tide | 2.26 |
| 100 year storm tide + 0.8m | 3.06 |
| 100 year storm tide + 1.1m | 3.36 |
| | |
| HAT | 2.17 |
| 1000 year storm tide | 2.36 |
| 1000 year storm tide + 0.8m | 3.16 |
| 1000 year storm tide + 1.1m | 3.46 |

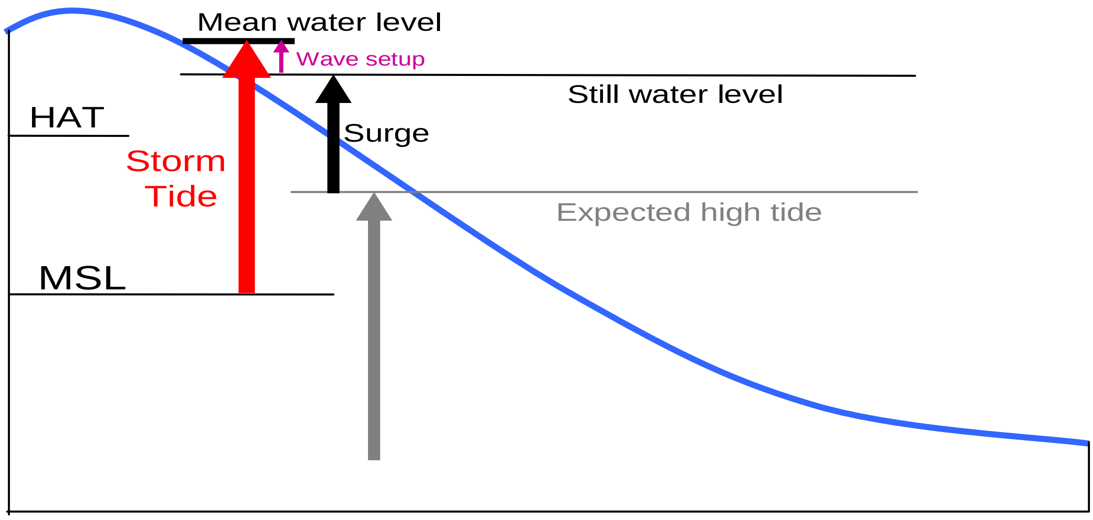


**Figure 5.2:** Definition diagram for inundation mapping.

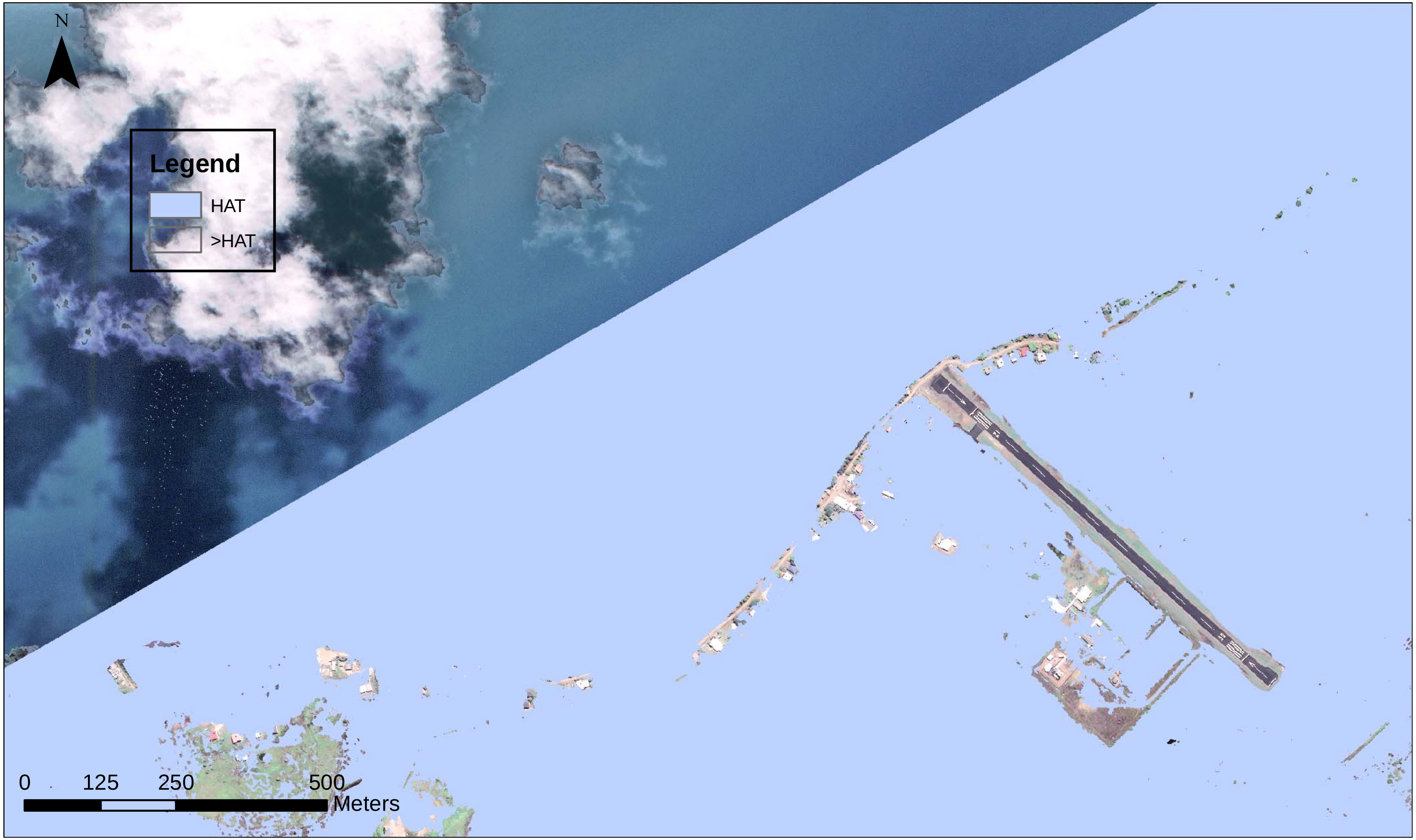


**Figure 5.3a:** Inundation at HAT (Highest Astronomical Tide).

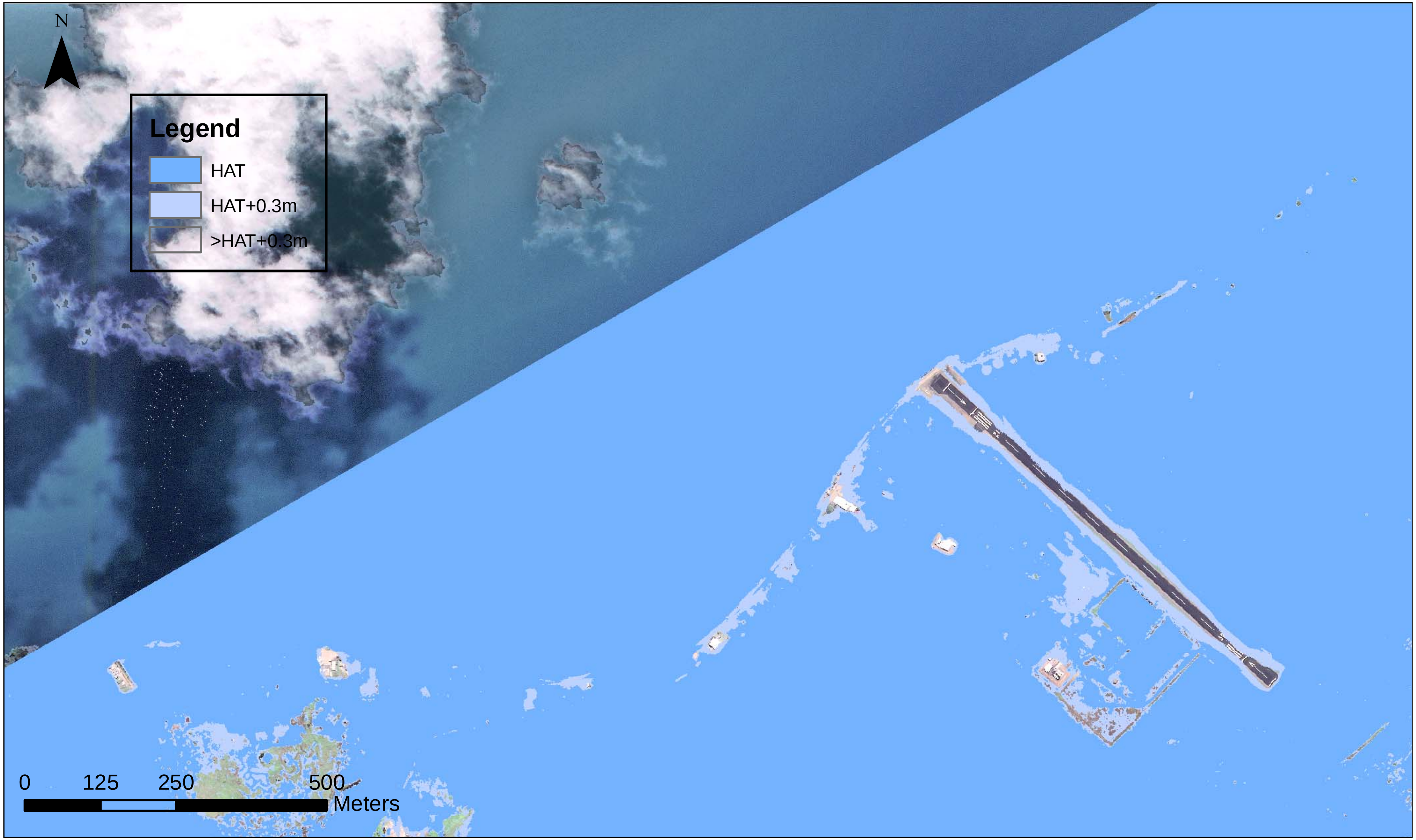


**Figure 5.3b:** Inundation at HAT with 0.3m sea level rise.

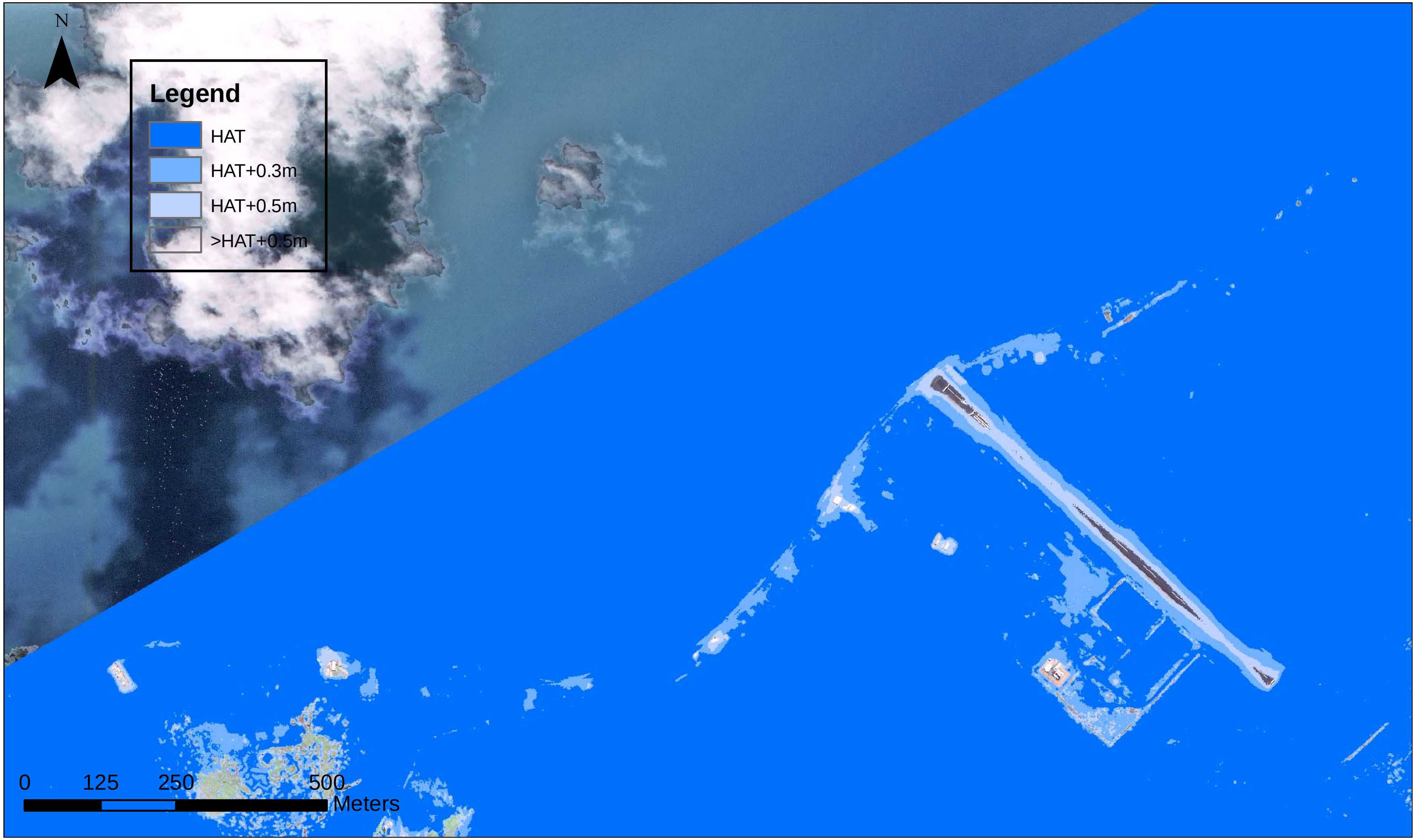


**Figure 5.3c:** Inundation at HAT with 0.5m sea level rise.

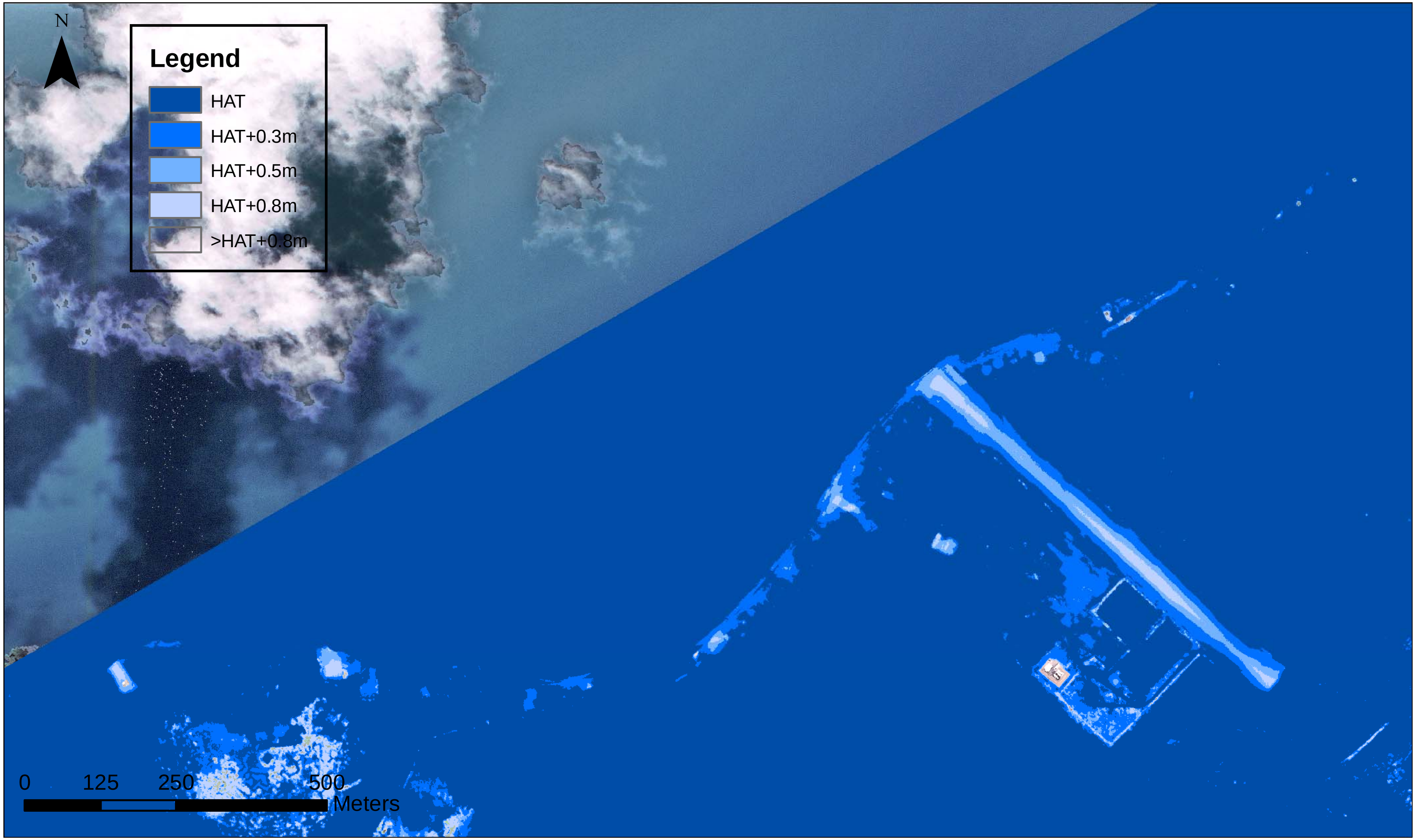


**Figure 5.3d:** Inundation at HAT with 0.8m sea level rise.

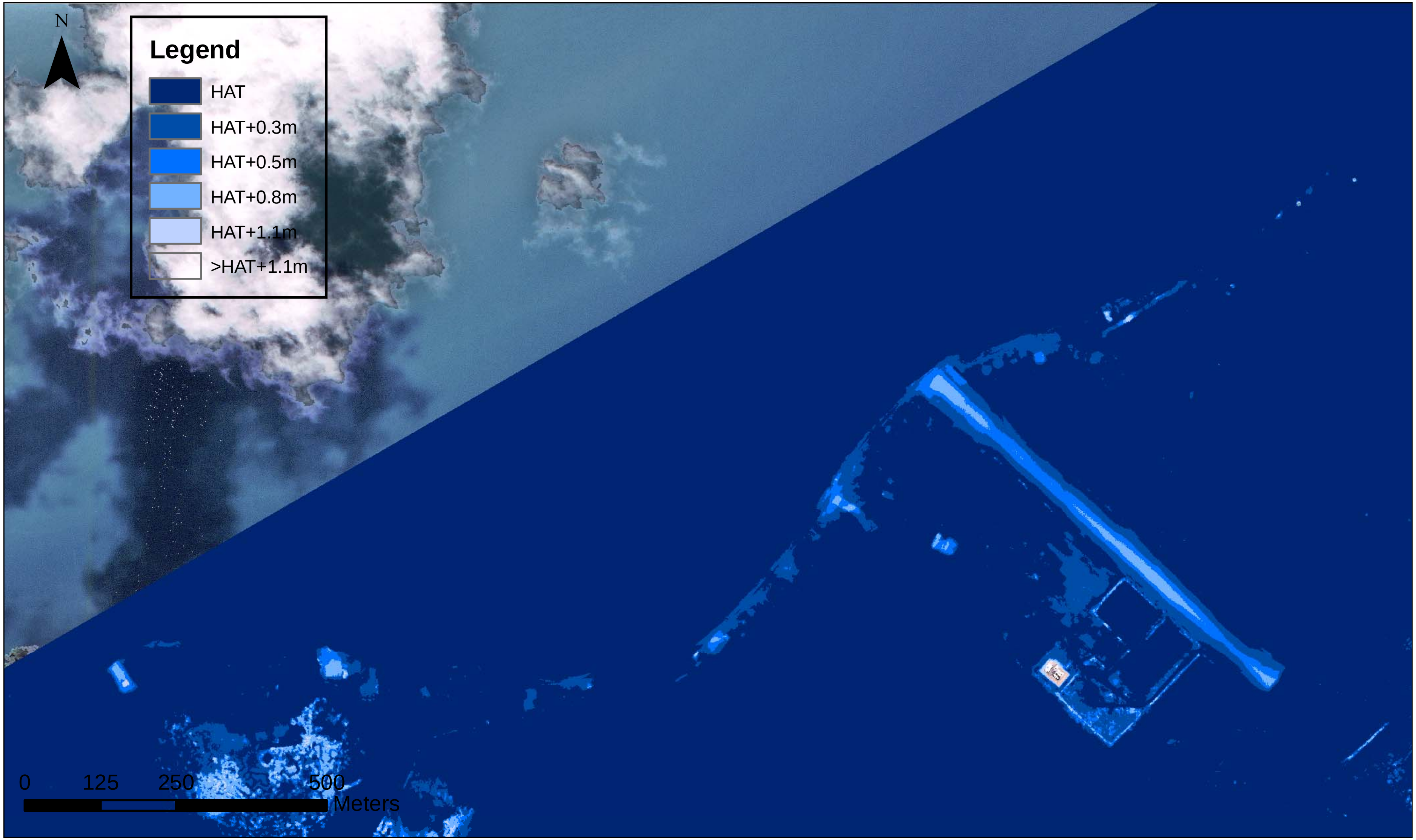


**Figure 5.3e:** Inundation at HAT with 1.1m sea level rise.

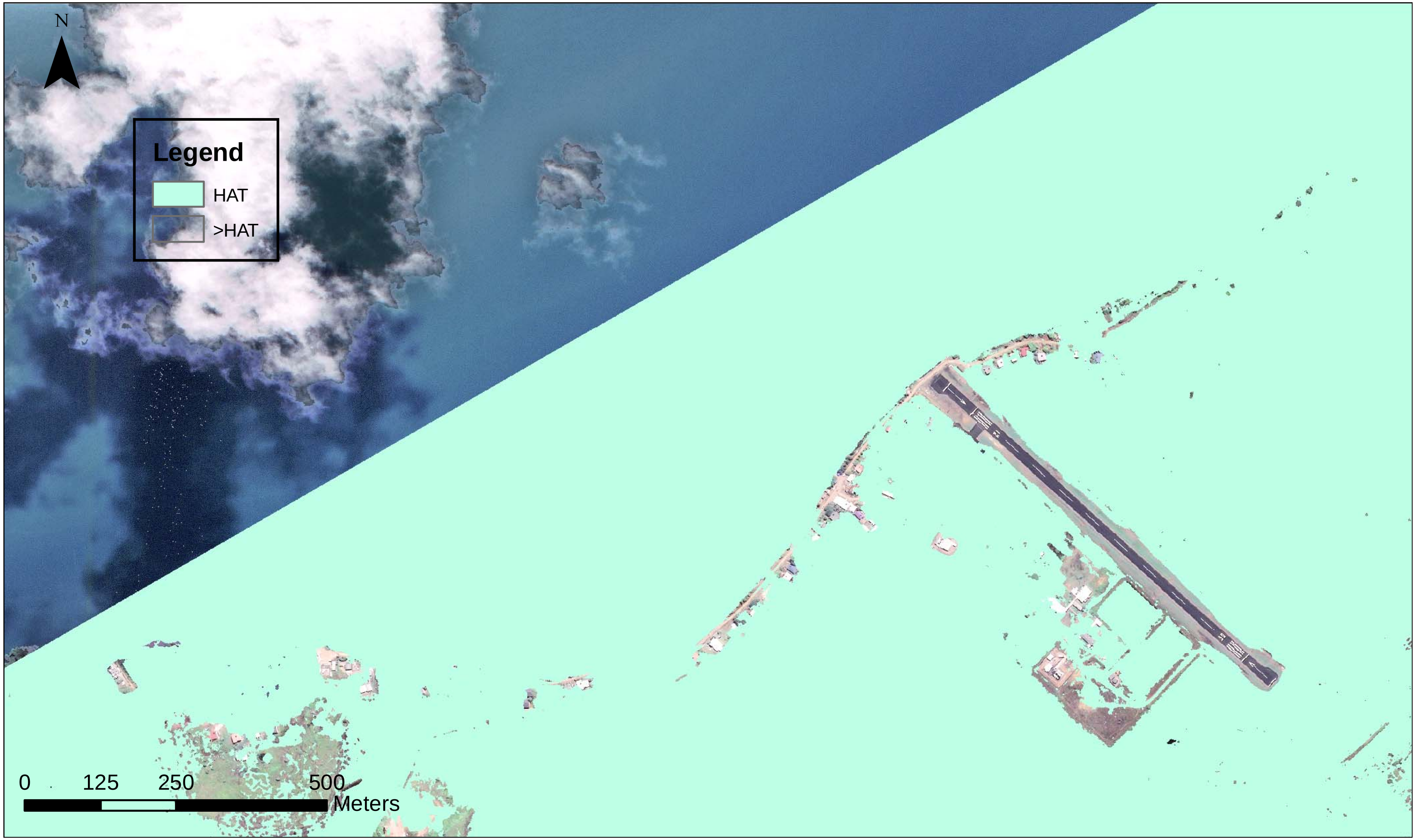


**Figure 5.4a:** Inundation at HAT (Highest Astronomical Tide).

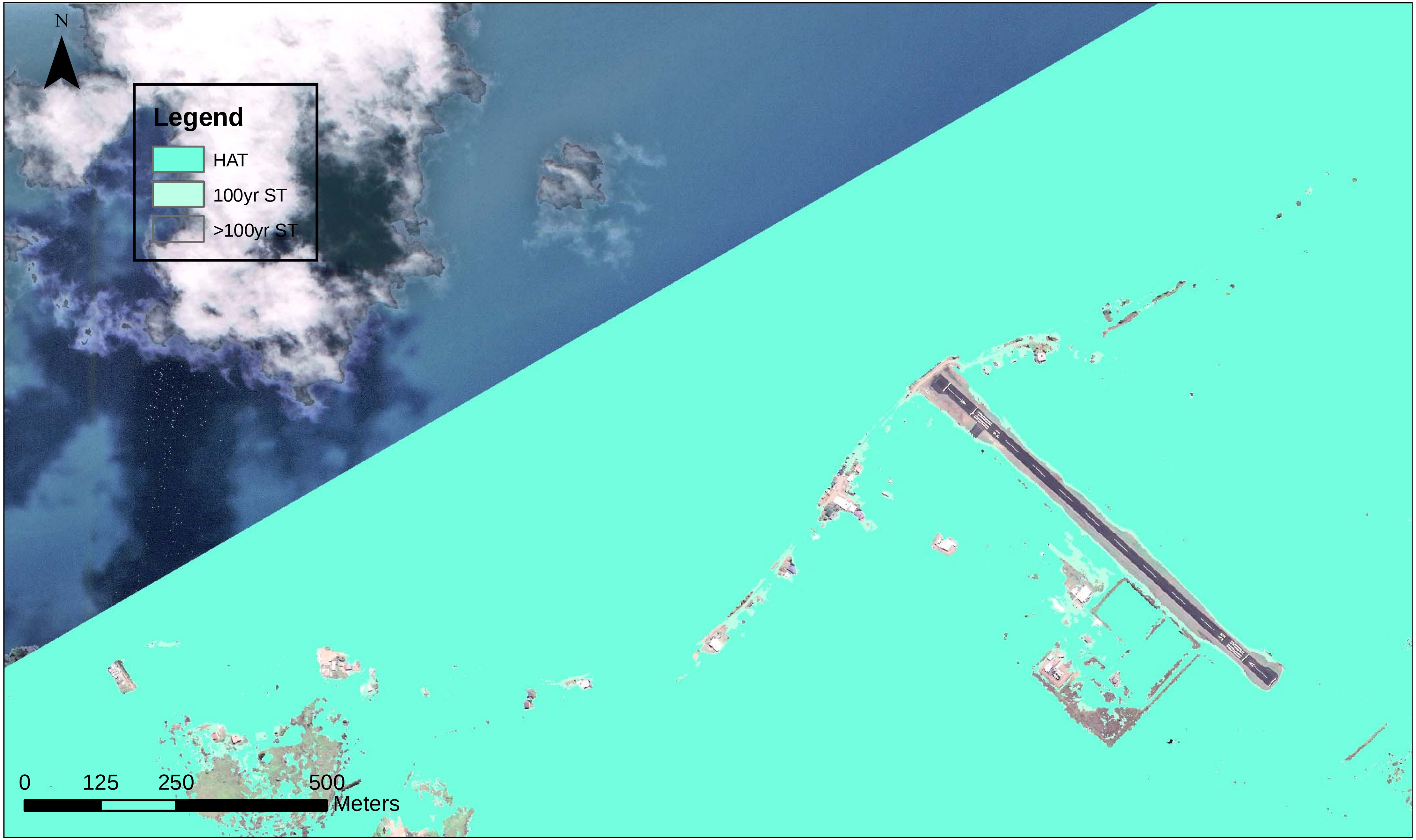


**Figure 5.4b:** Inundation at HAT with 100 year return period Storm Tide.

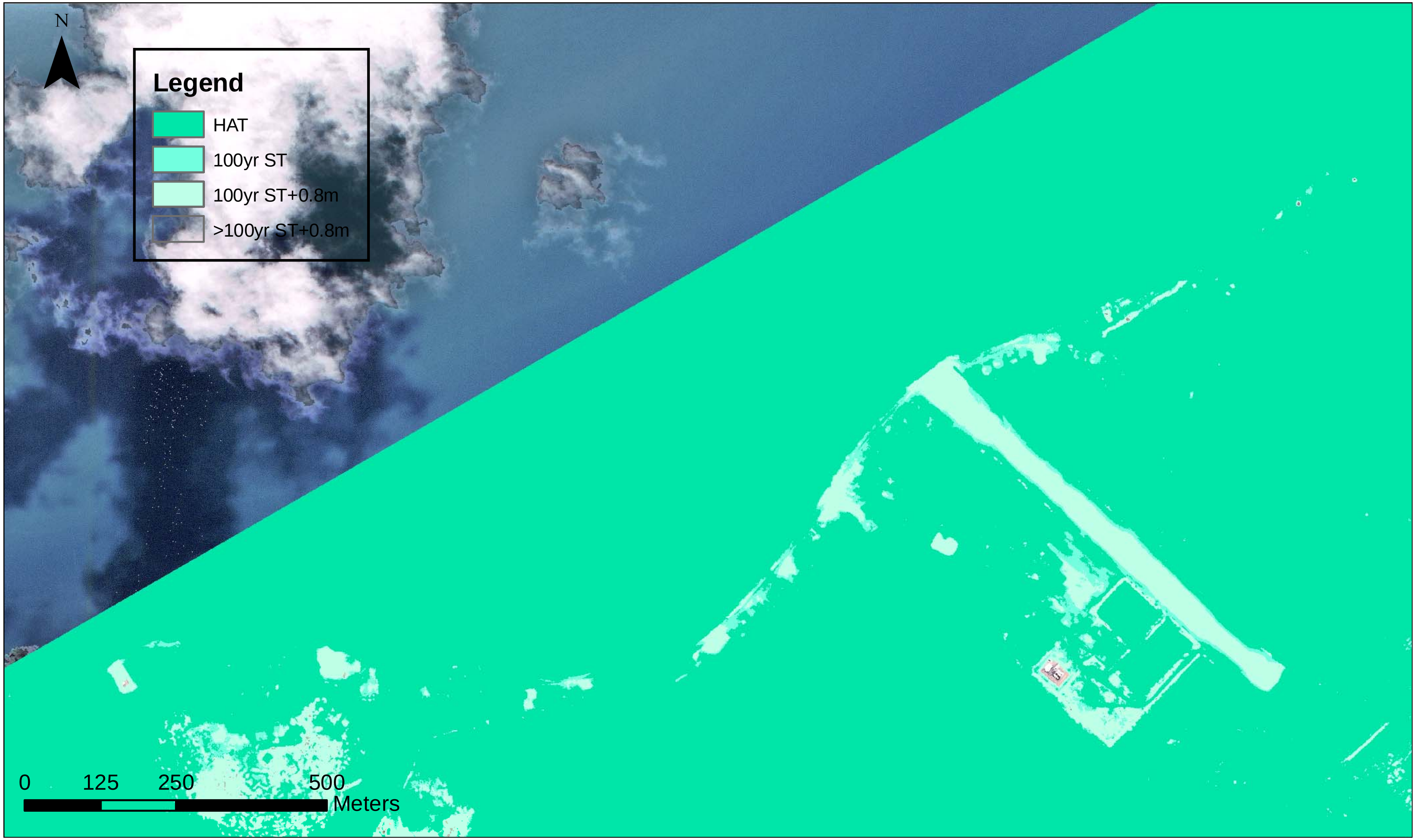


**Figure 5.4c:** Inundation at HAT with 100 year return period Storm Tide and 0.8m sea level rise.

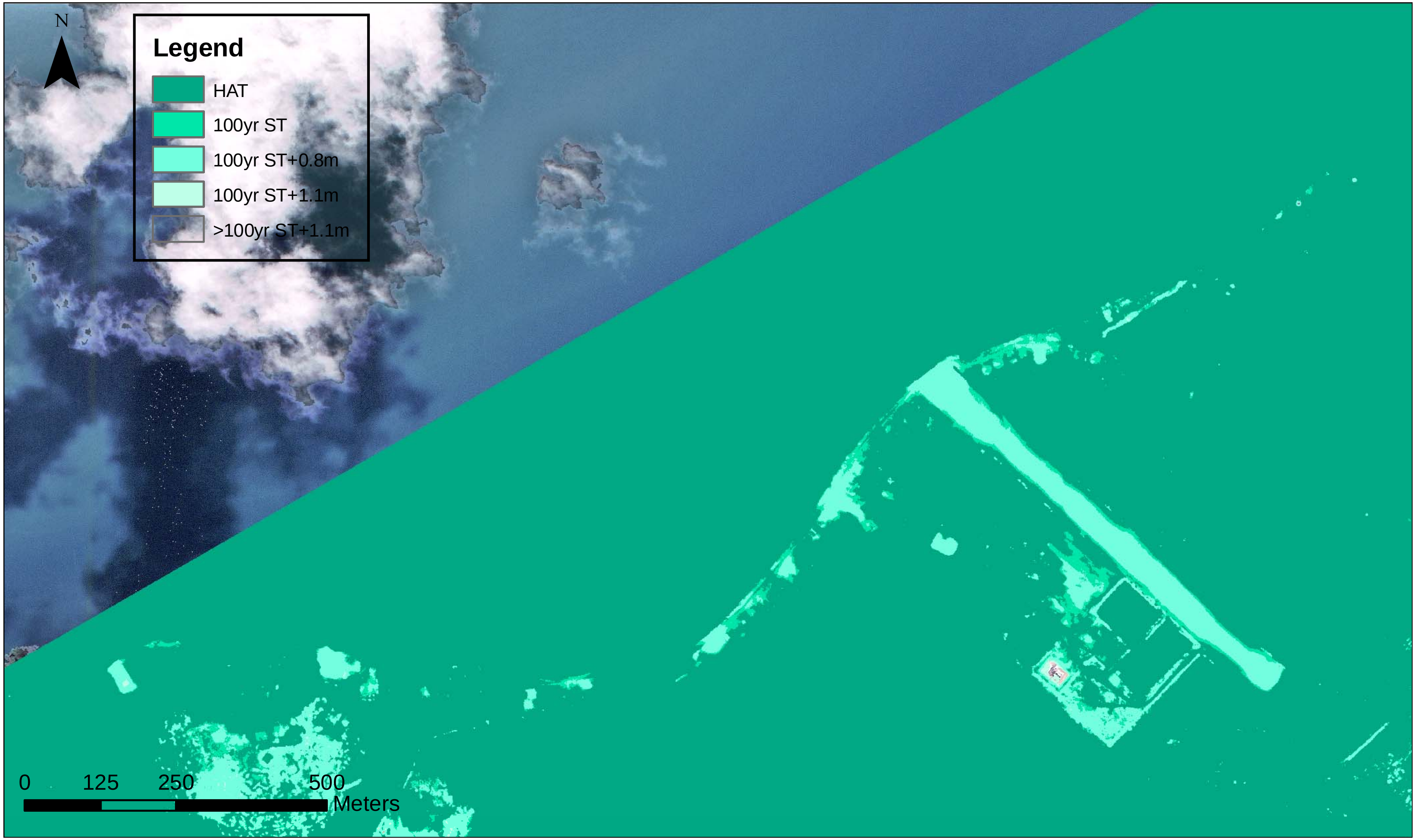


**Figure 5.4d:** Inundation at HAT with 100 year return period Storm Tide and 1.1m sea level rise.

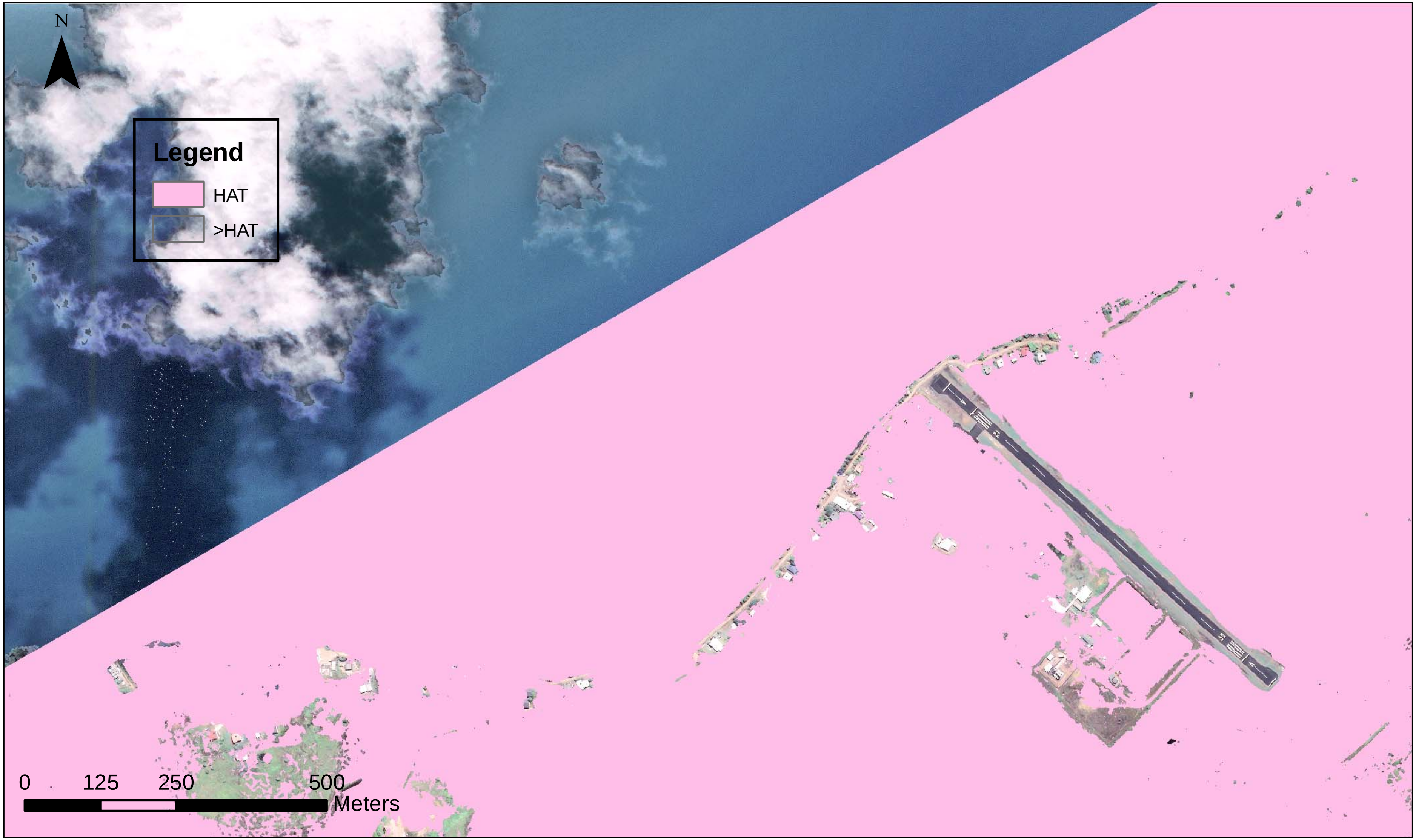


**Figure 5.5a:** Inundation at HAT.


**Figure 5.5b:** Inundation at HAT with 1000 year return period Storm Tide.

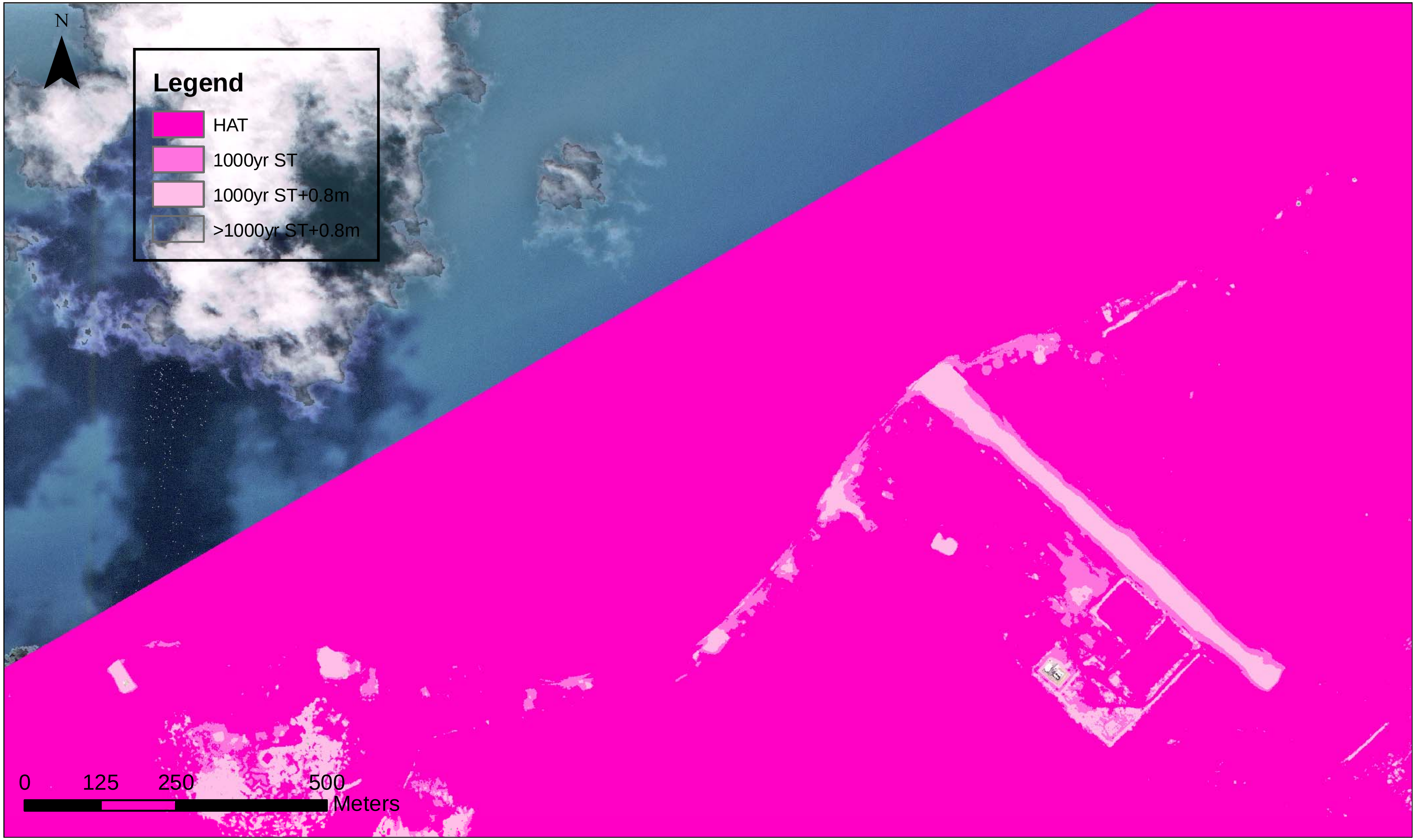


**Figure 5.5c:** Inundation at HAT with 1000 year return period Storm Tide and 0.8m sea level rise.

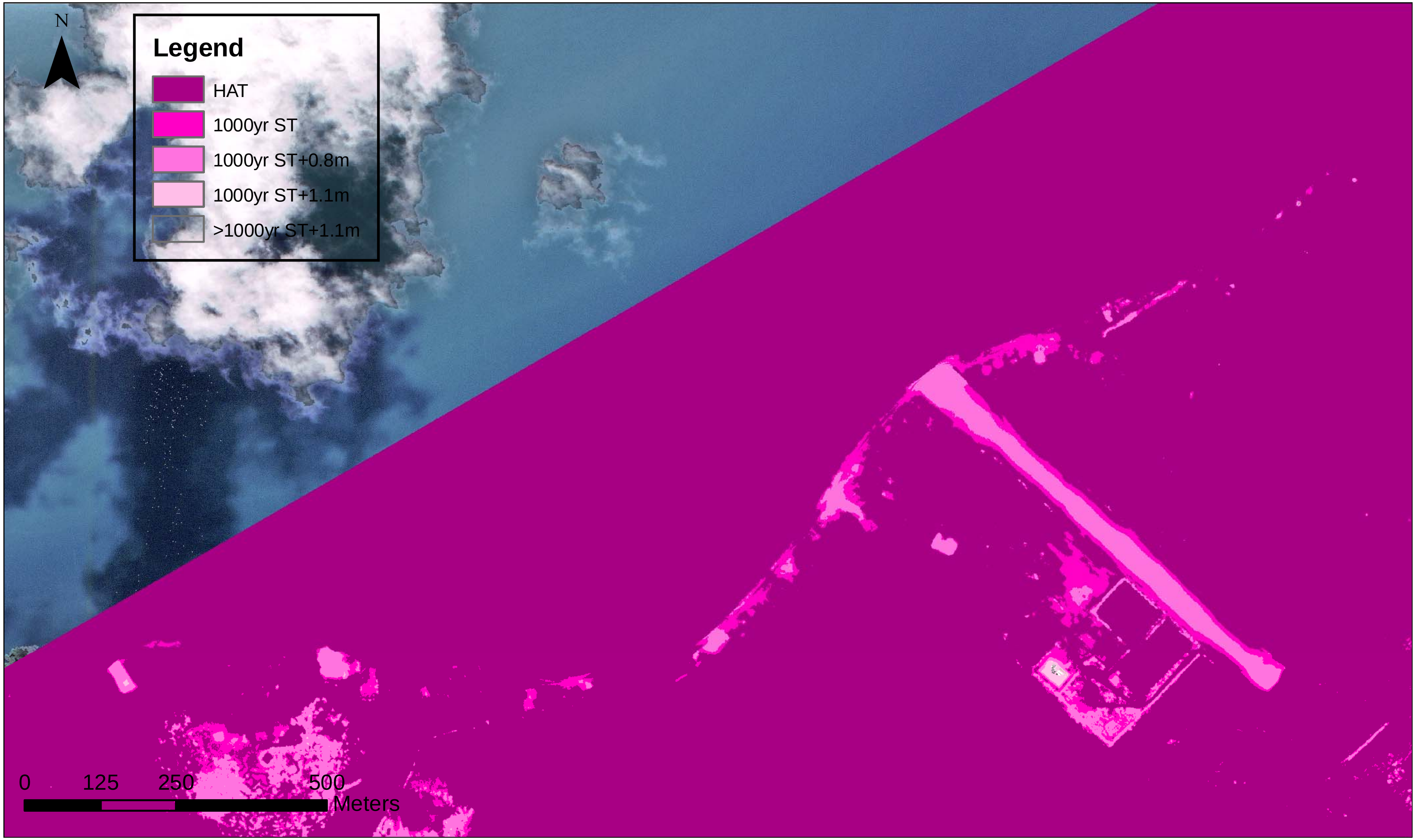


**Figure 5.5d:** Inundation at HAT with 1000 year return period Storm Tide and 1.1m sea level rise.

## 6. Asset replacement

The community has clearly stated that they do not wish to relocate, and undertaking an exercise to cost rebuilding the community should not be seen as pushing for this option. It does, however, provide a basis from which to compare other adaptation strategies. If relocation was ever to be considered by the community, there would need to be a lot of advance planning and many problems to solve. Some of these are:

- finding a new place where the community could re-establish that would be acceptable to the community members, and where land could be obtained;
- land ownership;
- determining what to do with the cemetery;
- determining how to appropriately recognise sites of cultural and historical importance;
- dealing with the situation of people refusing to move, or wishing to move elsewhere;
- and many more things.

The relocation of a whole community, or a large part of it, is a very rare event, and only happens in extreme circumstances. There are precedents, such as when some people from Saibai moved to the mainland in 1948. Some similar moves are contemplated or happening from islands in Melanesia and Polynesia.

The actual cost of rebuilding a community will vary significantly depending on the location. Such things as the nature of the coastline, the rock type, the slope, drainage, water availability and many more things determine the actual cost. Before a specific location is identified, the best estimate we can make is the replacement of present assets, and that is what we report here. We also assume that the relocation would be to an area in Torres Strait, so the costs of building in the area are used in the analysis.

The details of the OPCC to replace the identified assets on Saibai are in the attached report by Black and More, and they are not repeated here. The assets that are considered are listed in Section 4 of the Black & More report, and the full details are in Appendix 1. A summary of the opinion of probable construction costs is in Table 6.1.

The methodology used for the analysis is in Section 7 of the Black & More report. It is important to note that estimates are based on simultaneous construction on a green field (i.e. undeveloped) site. No allowance has been made for the cost of removal of existing infrastructure.

Probably the most difficult (and variable) aspect to establish relates to the marine facilities, which includes seawalls. If another site was chosen for relocation, it is highly likely that it would be chosen so that it is safe from erosion and inundation, and infrastructure would be planned accordingly. However, as it is almost certain that the Saibai community would want a site near the coast, to preserve as much as possible their way of life, some allowance needs to be made for infrastructure appropriate for a community that has a close association with the sea, and the number reported here is probably reasonable.

**Table 6.1:** Opinion of Probable Construction Costs by asset group (excluding GST).

| Infrastructure Asset | Opinion of Probable Construction Costs Saibai ($) |
|---|---|
| Sewer | 11,131,030 |
| Water | 8,303,464 |
| Roads | 13,853,700 |
| Stormwater \ Drainage | 682,716 |
| Marine Facilities | 7,473,000 |
| Airport | 2,902,250 |
| Buildings | 63,772,300 |
| Ergon | 12,000,000 |
| Telstra | 5,294,320 |
| Waste & Landfill Facilities | 499,000 |
| **TOTAL** | **125,911,780** |

## 7. Elevation

The other radical option considered is elevation of the community. This option involves importing material and elevating the land surface. There are a number of major problems associated with elevating the land surface:

- There would be significant disruption to the community while fill was being placed. People may have to move elsewhere for periods of time.
- Many of the assets would need to be replaced, or significantly renovated to deal with a higher land level.
- There would need to be significant landscaping work, and associated sea protection works.

On the positive side, the work could be staged, and areas could be elevated at such time as they need replacing anyway.

Black & More have provided an Opinion of Probable Cost to provide fill material from Cairns. This is based on transport using the "Colossus" barge (Figure 7.1). The cost estimate is \$140 per tonne, or \$380 per $m^3$. This is based on an uncompacted volume. Clearly, the cost would be much reduced if a local source of fill material could be found. However, the experience in the area is that local material is generally difficult to get. A recent example is the need to get material from Cairns for ground works at the new school on Mer.

In order to determine the approximate cost of elevating the community to various levels to provide protection, TIN models were used to estimate the volume below various surface levels. The same levels were applied as were used for the inundation analysis in Section 5. The TIN model in Figure 5.1 was used as a base, and various smaller areas identified that could be considered separately. Figures 7.2 and 7.3 should be referred to in this analysis.

The quantities of fill required, and the cost of the fill material, are given in Tables 7.1 and 7.2. The actual quantities and costs will be a little higher, perhaps by 10-20% to account for compaction and loss, and there is a substantial cost involved in getting the material to site and in its placement, perhaps another 20-30%. We have been unable to obtain better estimates. Therefore, the actual cost of elevating the ground level could be up to about 50% higher than the costs given. More significantly, many assets will require replacement or significant renovation in order to cope with the new levels. Examples would include, provision of drainage, resurfacing roads and the airport runway, elevating buildings that are not already elevated, and increasing the height of the seawall and retaining structures to cope with the new level. It is therefore likely that, depending on the level to which the surface is elevated, the cost of replacing or renovating affected assets could approach the cost of building a new community, as outlined in Section 6. However, elevation could be staged to coincide with planned renewal of assets due to them reaching the end of their useful life. In any of these cases, significant disruption to the community would occur.

Another option would be to selectively elevate parts of the community to provide safe houses and to protect the most important infrastructure. An option would be to elevate service facilities that are required to be elevated (for example, the water storage), elevate a previously undeveloped area (such as the Investigation Area) and build a different style of housing, at higher density, to accommodate people. Then, other areas could be elevated and rebuilt as required.

It is impossible, in this report, to cost all possible options.  What is clear is that elevation of the land surface to provide for storm tides and sea level rise is possible, and although it is likely to be more expensive than relocation, it is not out of the question, particularly if local sources of fill can be obtained, or the elevation can be staged, and combined with a change in the style of houses. A possible way forwards is discussed in Section 8.

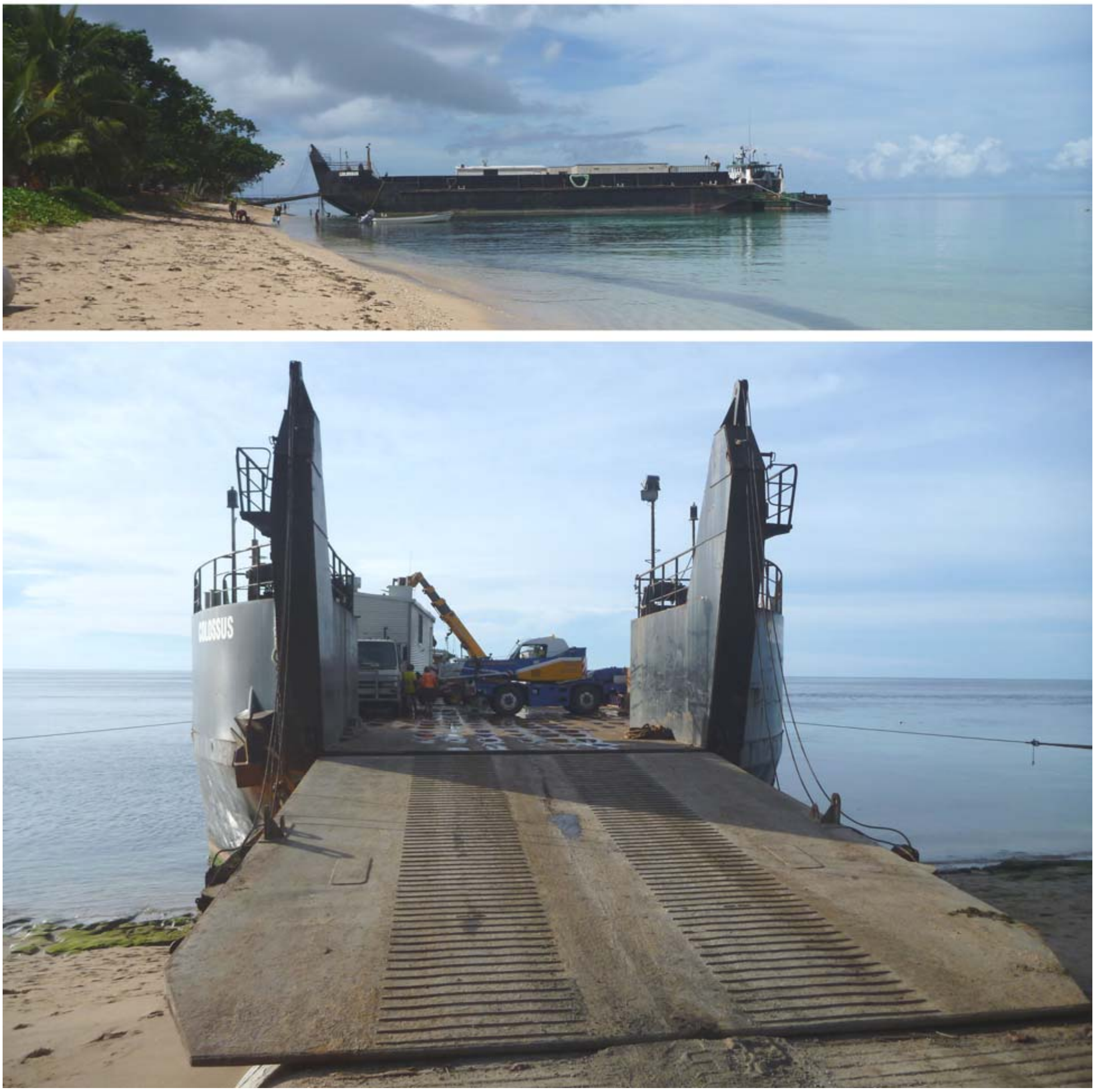


**Figure 7.1:**  The Colossus, with a capacity of 1500 tonnes.

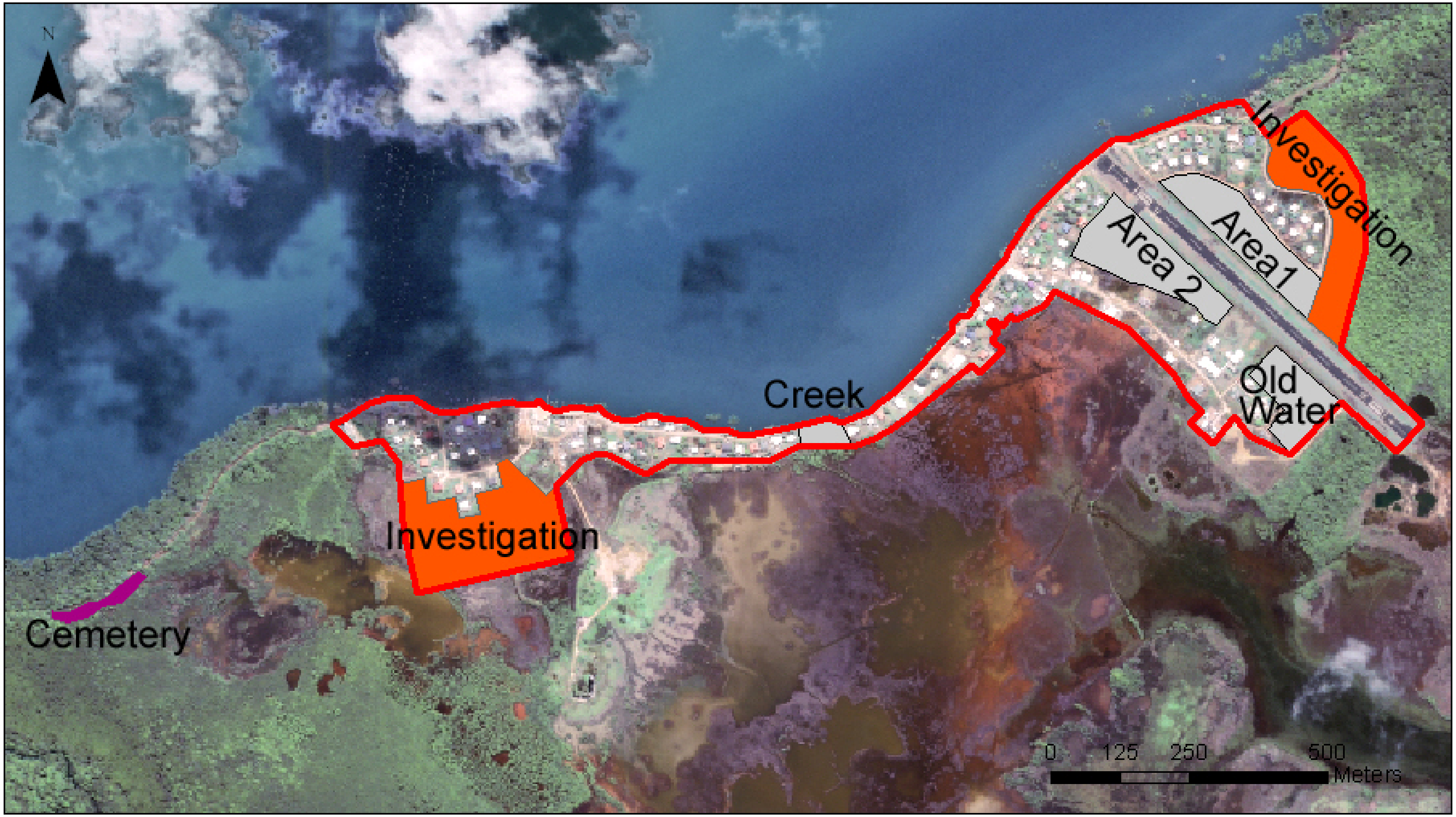


**Figure 7.2:** The area over which calculations of fill volume are made, and names used in the description. The areas highlighted in grey (the water facility, areas 1 and 2, the creek and the rubbish tip) are excluded for the purposes of calculating volume. The cemetery (purple), and the investigation areas (orange) are provided as separate estimates. In summary, “The Community” for which volume and cost is calculated (Tables 7.1 and 7.2) is the area highlighted in red, excluding all the shaded areas.

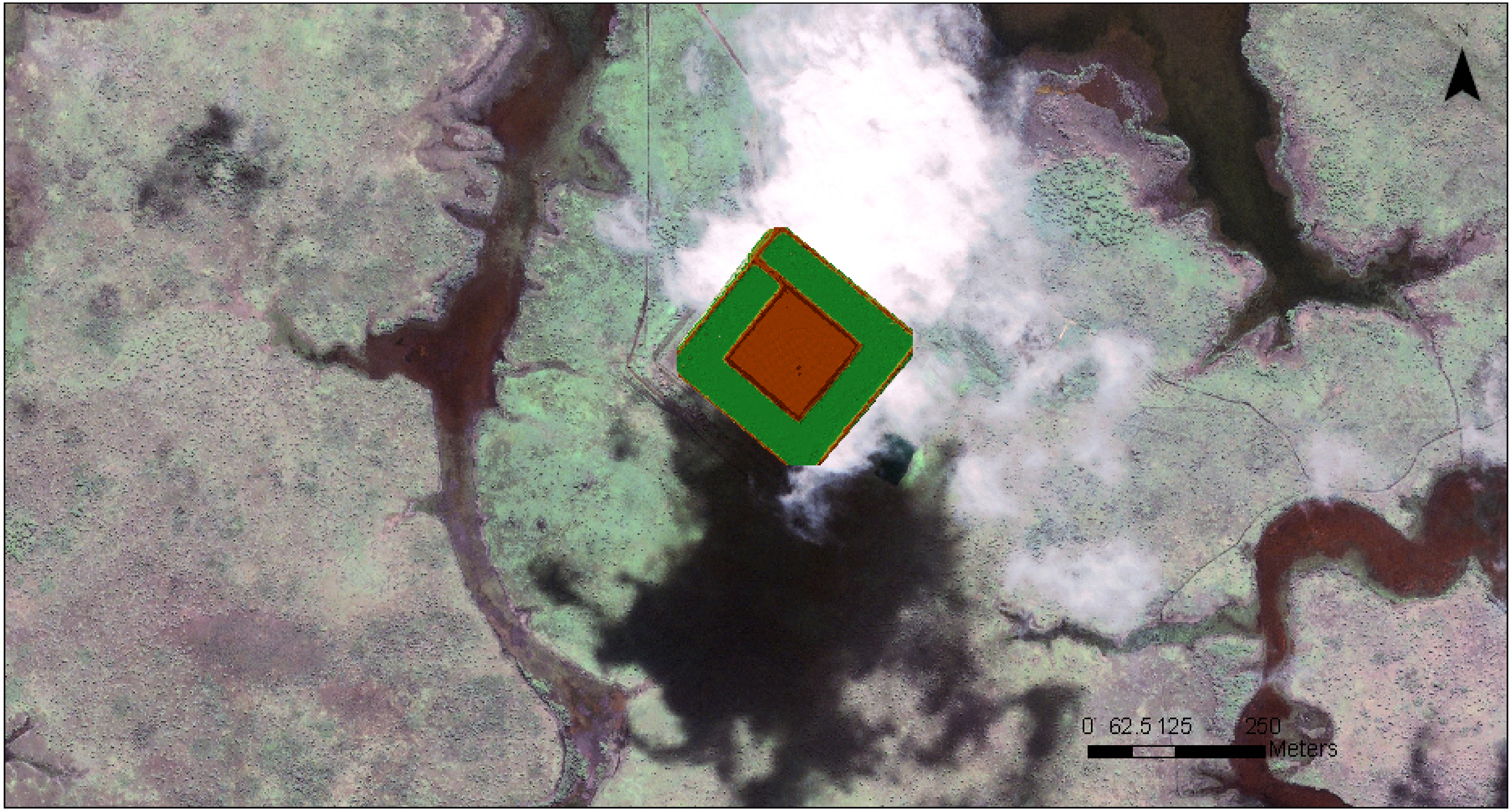


**Figure 7.3:** The area over which calculations of fill volume are made for the water storage area. The calculation is for raising the walls only (excludes the brown square in the middle).

**Table 7.1:** The volume of fill material ($m^3$) required to elevate areas to different levels. The definitions of the areas are provided in Figures 7.2 and 7.3

| Level | HAT | 100yr ST | 1000yr ST | HAT + 0.3m | HAT + 0.5m | HAT + 0.8m | 100yr ST + 0.8m | 1000yr ST + 0.8m | HAT + 1.1m | 100yr ST + 1.1m | 1000yr ST + 1.1m |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Level (m) | 2.17m | 2.26m | 2.36m | 2.47m | 2.67m | 2.97m | 3.06m | 3.16m | 3.27m | 3.3m6 | 3.46m |
| | | | | | | | | | | | |
| **Community** | **63645** | **82761** | **106062** | **133243** | **185933** | **269364** | **294559** | **322562** | **353380** | **378618** | **406697** |
| Cemetery | 1000 | 1251 | 1588 | 2011 | 2838 | 4110 | 4497 | 4928 | 5403 | 5791 | 6222 |
| Investigation West | 4535 | 6442 | 8961 | 12108 | 18674 | 30753 | 34712 | 39141 | 44021 | 48014 | 52451 |
| Investigation East | 22698 | 25784 | 29216 | 32992 | 39858 | 50157 | 53246 | 56679 | 60455 | 63545 | 66978 |
| Water Storage | 72 | 127 | 262 | 3176 | 11171 | 24247 | 28445 | 33242 | 38620 | 43072 | 48050 |

**Table 7.2:** The cost of unconsolidated fill material (in Millions of Dollars) required to elevate areas to different levels. The definitions of the areas are provided in Figures 7.2 and 7.3

| Level | HAT | 100yr ST | 1000yr ST | HAT + 0.3m | HAT + 0.5m | HAT + 0.8m | 100yr ST + 0.8m | 1000yr ST + 0.8m | HAT + 1.1m | 100yr ST + 1.1m | 1000yr ST + 1.1m |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Level (m) | 2.17m | 2.26m | 2.36m | 2.47m | 2.67m | 2.97m | 3.06m | 3.16m | 3.27m | 3.3m6 | 3.46m |
| | | | | | | | | | | | |
| **Community** | **24.2** | **31.4** | **40.3** | **50.6** | **70.7** | **102.4** | **111.9** | **122.6** | **134.3** | **143.9** | **154.5** |
| Cemetery | 0.4 | 0.5 | 0.6 | 0.8 | 1.1 | 1.6 | 1.7 | 1.9 | 2.1 | 2.2 | 2.4 |
| Investigation West | 1.7 | 2.4 | 3.4 | 4.6 | 7.1 | 11.7 | 13.2 | 14.9 | 16.7 | 18.2 | 19.9 |
| Investigation East | 8.6 | 9.8 | 11.1 | 12.5 | 15.1 | 19.1 | 20.2 | 21.5 | 23.0 | 24.1 | 25.5 |
| Water Storage | 0.0 | 0.0 | 0.1 | 1.2 | 4.2 | 9.2 | 10.8 | 12.6 | 14.7 | 16.4 | 18.3 |

## 8. Adaptation options

There is a requirement for immediate work to rebuild the seawall and construct a rear bund wall, as well as undertake some work at the cemetery, as outlined in various TSRA submissions for funding, and as costed and described by AECOM (2011), even if in the longer term, other options as described below form part of the plan to adapt to climate change and, in particular, sea level rise. This is because the options described below can not be immediate. However, it is important to have a long-term plan.

The community has stated that they do not wish to relocate. However, some idea of the cost of doing so provides a basis against which to compare other options.

*Option A:* Do nothing beyond the urgent measures already costed and wait and see what happens.
Positives: Cost is low compared to other options
Negatives: Although the current proposals may protect Saibai from inundation from all but the most extreme events for the next few years, they do not account for sea-level rise that we are now required to consider.
Discussion: There remain uncertainties in our understanding of climate change. At present Saibai is seriously inconvenienced by inundation, but at the moment, safety is not really a major issue. There may be some benefits to waiting for a period of time before major decisions are made, perhaps identifying a trigger point at which a backup plan is activated (which may be one of the options below).

*Option B:* Relocation of the community
Positives: The community would be safe from inundation events.
Negatives: Disruption to peoples' lives, cultural disruption; cost.
*Discussion:* We have provided an estimate of the cost of replacing current assets on Saibai at another location. No account has been taken of the disruption to people and the culture that a move like this would have. .In addition, there are major difficulties with respect to finding another location where people would be comfortable going, and where land is available.

*Option C:* Elevation of the entire community at one time
Positives: The community could be made safe from inundation events, and could stay on Saibai into the foreseeable future.
Negatives: Disruption to people's lives, cost.
Discussion: This is the most costly option. It would mean major disruption to people (probably involving most people moving from the island temporarily), and the rebuilding or renovation of most community assets. The level of elevation would need to be established with imperfect information about the future. A major problem on Saibai is its geographical spread. It is virtually impossible to come up with a solution involving elevation and fortification that is consistent with a community spread out along a coastal road.

*Option D:* Staged elevation of the community, meaning the community could stay on Saibai into the foreseeable future.
Positives: Safe areas would be provided, and costs can be reduced
Negatives: Disruption to people's lives and possibly changed residential styles; cost.

Discussion: There are a range of possible options under this broad heading. Areas could be identified for elevation at such time as the assets, or a significant proportion of the assets in an area, need replacing anyway. That would mean that the total *extra* cost would be the cost of purchasing and placing the fill. Alternatively, an area such as an investigation area (orange in Figure 7.2) could be elevated, higher density housing built which would be safe from inundation, and other areas subsequently elevated as the need arises. This would minimise the amount of fill required whilst maintaining the community.

## 9. Other considerations

Adaptation to inundation raises a number of issues that need to be thoughtfully discussed. Some of these are briefly mentioned below.

*Acknowledgement of the problem, and participation in a solution*

It is very important that the people in the community understand some things about climate change and the future, particularly being a community near the coast, and one of the most vulnerable communities in Australia. The people of Saibai and Torres Strait have a specific set of problems, associated with isolation, costs of living in the area, and being a coastal people. However, similar problems are faced by many people in Australia and around the world. All Australians need to be prepared to participate in trying to solve the problem, and every person has a role to play. We encourage Saibai people to talk about the things raised in this report, and give feedback to the community leaders and to us.

*Understanding the problem*

Talk of climate change related problems often leads to unnecessary fear. Climate change problems do not happen overnight, and not all natural hazards are caused by climate change. We know that storms, floods, tsunami, fires and other hazards happen now, and Saibai has first hand experience of major inconvenience caused by inundation. It is highly likely that inundation will get more frequent or worse in the future. We have time to plan and to try to solve some of the problems over the years to come. We should not panic, but we need to start planning and doing things now. Saibai unfortunately has a more immediate problem than most other Torres Strait communities.

*Not building new things in vulnerable places*

We should not build new houses or other infrastructure in areas that have been identified as vulnerable, unless they are absolutely essential and we are willing to pay the extra cost to protect them and/or acknowledge that they may only have a short useful life. Unfortunately, all of Saibai is vulnerable, and therefore planning is more urgent as any new infrastructure will be vulnerable unless other actions are taken.

*Replacing infrastructure*

Before any building or other infrastructure is rebuilt when it gets old and needs replacing, we must think about whether the location is in a particularly risky location. If it is, we should try to find another place for that building or infrastructure, or build it in such a way that the risk is minimised.

*Land ownership*

Clearly, some places are more vulnerable than others, and the most vulnerable places should not have people living there. Moving to higher ground is sometimes an option (not in Saibai), but this is normally problematic as people may be required to move from family lands, and there will be issues of land ownership and traditional rights that the community needs to work through. These issues can only be worked out in the community.

*Other solutions*

Occasionally there are other ideas that people come up with. If there are other options that people think might work for Saibai please tell us, so that we can think about them and discuss them with you.

*Cost of work*

Unfortunately most actions, particularly those that involve relocation, building seawalls, elevating land and replacing infrastructure cost enormous amounts of money, and there needs to be a sense of reality in what is decided upon. The people of Saibai, and every other community in Torres Strait and Australia, need to work together to prioritise what needs to be done. There will never be unlimited money to deal with all the problems, so it is important that the community prioritises things that are important to the community, even though everybody might not agree, so that these can be promoted with government agencies.

## 10. What happens now?

This report has a lot of information in it. We thank everybody who takes the time to look at it, and we welcome your comments and suggestions. Please contact us (details below) if you have any questions. You can also talk to people in the Land and Sea Management Unit of TSRA.

Please discuss the issues with your friends and the community leaders. Over the next few months, we will be coming to Saibai to answer questions and to work with the community leaders and anybody who wants to be involved, to produce a *Coastal Management Plan* for Saibai. We hope that this plan will set out your priorities, and then we can work together to try to put the plan into action. Remember that it is not our role to make decisions for your community, that is up to you, but we will support you in the decision making process as much as we can.

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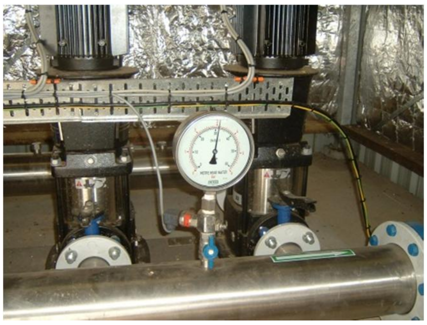
# Boigu & Saibai Asset Replacement

James Cook University

# Asset Replacement Report



Black & More

April 2012

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| | **Title:** | Boigu & Saibai Asset Replacement Report |
| | **Project Manager:** | David Black |
| | **Author:** | David Black |
| | **Client:** | James Cook University |
| | **Client Contact:** | Dr Kevin Parnell |
| | **Client Reference:** | 6994 – Boigu & Saibai Asset Replacement |
| | **Synopsis:** | Report on the estimated replacement cost for existing infrastructure on Boigu & Saibai island, Torres Strait |



| REVISION/CHECKING HISTORY | | | | | |
|---|---|---|---|---|---|
| **Rev No.** | **Author** | **Reviewer** | **Approved for Issue** | | |
| | | | **Name** | **Signature** | **Date** |
| Original Issue | D. Black | G. O'Brien | G. O'Brien | G.O'Brien | 21/04/12 |

| DISTRIBUTION | REVISION | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Original | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
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# CONTENTS

# 1 EXECUTIVE SUMMARY

Black & More have been engaged by James Cook University (JCU) to undertake a desktop study and provide an opinion of probable construction cost (OPCC) to replace existing infrastructure assets on Boigu & Saibai Island in the Torres Strait.

The existing infrastructure assets in each community have been identified and an OPCC to replace these existing infrastructure assets on Boigu & Saibai Island has been provided based on 2012 construction costs.

Table 1 summarises the opinion of probable construction costs for the existing infrastructure assets on Boigu and Saibai.

Black & More have also established a price to import select fill to Boigu & Saibai Island from Cairns. These prices are summarised in Table 2.

All listed in this report are exclusive of GST unless noted otherwise.

| Infrastructure Asset | Opinion of Probable Construction Costs Boigu ($) | Opinion of Probable Construction Costs Saibai ($) |
|---|---|---|
| Sewer | 9,947,540 | 11,131,030 |
| Water | 8,386,570 | 8,303,464 |
| Roads | 6,817,000 | 13,853,700 |
| Stormwater \ Drainage | 764,300 | 682,716 |
| Marine Facilities | 5,265,000 | 7,473,000 |
| Airport | 2,875,000 | 2,902,250 |
| Buildings | 53,221,120 | 63,772,300 |
| Ergon | 11,000,000 | 12,000,000 |
| Telstra | 4,634,056 | 5,294,320 |
| Waste & Landfill Facilities | 402,000 | 499,000 |
| **TOTAL** | **103,312,586** | **125,911,780** |

**Table 1 Summary of Opinion of Probable Construction Costs**

| Item | Opinion of Probable Costs ($) Fill Material |
|---|---|
| Purchase of select fill from Cairns (1500 tonnes) | 16,725 |
| Hire of Colossus Barge (Capacity 1500 tonnes) | 187,500 |
| Port Fees (Based on 1500 tonnes) | 6,075 |
| **Total (Based on 1500 tonnes)** | **210,300** |

**Table 2 Import of Select Fill**

# 2 SCOPE

The scope of this report includes:

1. Provide a desktop study to identify and quantify the existing infrastructure assets on Boigu and Saibai Islands
2. Provide an Opinion of Probable Construction Cost (OPCC) to replace the identified assets on Boigu and Saibai
3. Provide an OPCC for the provision of bulk fill to Boigu and Saibai Islands

# 3 BOIGU ISLAND - OVERVIEW

Boigu is a low flat, island consisting primarily of mangroves and wetlands. It is located in the North Western Torres Strait approximately 6km south Papua New Guinea.

The island is approximately 17km long by 6km wide, with an area of 6,630 hectare and is one of the larger islands in the Torres Strait.

The community is located on the Northern side of the island and is home to approximately 300 people.

# 4 BOIGU ISLAND - EXISTING INFRASTRUCTURE

## 4.1 Sewer

Boigu Island has a fully reticulated sewerage scheme incorporating gravity sewers, manholes, a pump station, rising main, package sewerage treatment plant and ocean outfall.

The scheme incorporates approximately 1900m of sewer reticulation.

## 4.2 Water

The Boigu Island Water Supply is a composite system based around rainwater harvesting and desalination. A 20ML artificial catchment and covered storage lagoon collects rainfall in the wet season. This water is augmented by supply from a reverse osmosis desalination unit located adjacent to the storage.

Water is collected from the sea by a submersible intake attached to the jetty on the North coast.

The water reticulation network on Boigu includes approximately 1900m of water reticulation.

## 4.3 Roads

The sealed roads on Boigu Island are primarily constructed of 4m wide 100mm thick fibre reinforced concrete on a stabilised sub grade.

There is approximately 3.5km of sealed road in the community.

## 4.4 Stormwater \ Drainage

Due to the low lying nature of Boigu Island stormwater is generally directed using surface flow with limited underground pipework.

Culverts have been installed where necessary to direct surface water away from the community and facilitate drainage.

The installed culverts are generally between 450mm and 600mm diameter.

A concrete lined drain approximately 330m in length has been constructed to drain the primary school with a 300m 4m wide earth drain constructed immediately north of the airstrip.

## 4.5 Marine Facilities

The marine facilities at Boigu include a precast concrete barge ramp with landing dolphins and a narrow timber-decked, finger pier.

A seawall has been constructed using a mixture of conventional rock armour and pattern placed Seabee units to protect the Northern coastline and minimises tidal inundation.

An earthen bund wall has been constructed around the perimeter of a future development area on the South East corner of the community.

## 4.6 Airport

The Boigu Island airport consists of a 780 metres long by 60m wide sealed all-weather airstrip located immediately South of the community. The airstrip has been constructed on an East-West alignment to suit the prevailing winds. Associated facilities include a hardstand apron, shelter (waiting area) and helipad.

The Airstrip is fully fenced.

## 4.7 Buildings

The existing building infrastructure on Boigu Island includes the following structures:

- 62 houses
- Primary School
- Health Care Centre
- Church
- Community Hall
- Childcare Centre
- Various workshops and sheds
- Commercial Freezer Shed
- Guesthouse
- IBIS Store
- Council Office
- Police Station

A full list of the identified buildings can be found in Appendix 1

## 4.8 Ergon

Electricity on Boigu Island is supplied from a power station which is located at the Western end of the community. Ergon Energy are responsible for the generation of electricity on behalf of the Queensland Government.

Electricity is generated by diesel generator sets (gensets) which are sized to match the electricity demands of the community.

There is approximately 1800m of electrical reticulation cable installed on Boigu Island

## 4.9 Telstra

Telecommunications Infrastructure on Boigu consists of a small Telstra tower which transfers signals to the existing underground network.

There is approximately 1300m of Telstra cabling installed on the Island.

## 4.10 Waste & Landfill Facilities

Boigu currently has a landfill facility which is located the Western end of the village near the existing cemetery.

A bund wall has been constructed around the landfill to prevent tidal inundation of the facility.

Waste is currently collected by rubbish truck and deposited at the landfill facility.

A wash-down facility has been constructed at the council shed located near the barge ramp.

# 5 SAIBAI ISLAND - OVERVIEW

Saibai is a low flat, island consisting primarily of mangroves and wetlands. It is located in the Northern Western Torres Strait approximately 3km South of Papua New Guinea and 40km East of Boigu Island.

The island is slightly larger than Boigu with dimensions of approximately 21km long by 5km wide. The area of the island is approximately 10,790 hectares.

The community is located on narrow strip of beachfront on the North Western side of the Island and is home to approximately 380 people.

# 6 SAIBAI ISLAND - EXISTING INFRASTRUCTURE

## 6.1 Sewer

Saibai Island has of a fully reticulated sewerage scheme incorporating gravity sewers, manholes, three pump stations, a lift station, rising main and package sewerage treatment plant.

The scheme incorporates approximately 3200m of sewer reticulation.

## 6.2 Water

The Saibai Island water supply is drawn from a 6.5 hectare constructed catchment and a centrally located covered and lined water lagoon.

Harvested water is pumped to and treated at a treatment plant and then pumped to a ground level reservoir from where it is delivered to Community via 80mm reticulation mains.

Pressure is maintained by a variable speed drive (VSD) pump station.

The water reticulation network on Saibai includes approximately 3,300m of water reticulation.

## 6.3 Roads

The sealed roads on Saibai Island are primarily constructed of 4m wide 100mm thick fibre reinforced concrete on a stabilised sub grade.

There is approximately 5km of sealed road in the community.

## 6.4 Stormwater \ Drainage

Due to the low lying nature of Saibai Island stormwater is generally directed using surface flows with limited underground pipework.

Culverts (including headwalls and aprons) have been installed East of the barge ramp and on both the Eastern and Western side of the Airstrip to facilitate drainage of low lying area behind and within the community and direct surface water away from the community.

## 6.5 Marine Facilities

The marine facilities at Saibai include a precast concrete barge ramp with landing dolphins, a timber finger pier.

The barge ramp and finger facilities are accessed from the deep water by a dredged channel, which is marked by navigational buoys.

A rock seawall and earthen bund wall have been constructed to protect the coastline and minimises tidal inundation.

## 6.6 Airport

The Saibai Island airport consists of a 750 metres long by 60m wide sealed all-weather airstrip located at the Northern end of the community

Associated facilities include and handstand area, apron, helipad and shelter (waiting area).

The Airport is fully fenced.

## 6.7 Buildings

The existing building infrastructure on Saibai Island includes the following structures:

- 88 houses
- Primary School
- Health Care Centre
- Church
- Community Hall
- Childcare Centre
- Various workshops and sheds
- Guesthouse
- IBIS Store
- Council Office
- Police Station

A full list of the identified buildings can be found in Appendix 2

## 6.8 Ergon

Electricity on Saibai Island is supplied from a l power station which is located at the Southeast end of the community near the barge ramp. Ergon Energy are responsible for the generation of electricity on behalf of the Queensland Government.

Electricity is generated by diesel generator sets (gensets) which are sized to match the electricity demands of the community.

There is approximately 4,500m of electrical reticulation cable installed on Saibai Island

## 6.9 Telstra

Telecommunications Infrastructure on Saibai consists of a small Telstra tower which transfers signals to the existing underground network.

There is approximately 2,800m of Telstra cabling on the Island.

## 6.10 Waste & Landfill Facilities

The Saibai Island landfall facility is located at the Western end of the community adjacent to the Telstra Tower.

The landfill facility is fully fenced and serviced by a concrete road.

Waste is currently collected by a council rubbish truck and burnt onsite where possible.

A bund wall has been built around the facility to prevent inundation during high tides.

A “wash-down” facility is located near the barge ramp.

# 7 OVERVIEW AND METHODOLOGY OF DETERMINING OPINION OF PROBABLE CONSTRUCTION COSTS FOR BOIGU & SAIBAI

Black & More undertook a desktop review of the existing infrastructure assets on Boigu and Saibai Islands.

This concluded that the majority of the existing infrastructure has been constructed over the past fifteen (15) to twenty (20) years.

In order to provide an opinion of probable construction cost (OPCC) for the replacement of this infrastructure, based upon today's marketplace, the replacement value has been estimated using a combination of the following:

- Recent construction contract prices for similar infrastructure works in the Torres Strait region.
- The Island Coordinating Council, Infrastructure Support Unit (ISU) (2005) Asset Database and Torres Strait Island Regional Council (TSIRC) Asset Database
- Actual construction costs adjusted by an indexation of 5 per cent per annum to reflect the current replacement cost of the assets.
- Advice from Service Authorities

The indexation figure of 5 per cent per annum was determined with reference to both the Productivity Price Index (PPI) and the Local Government Cost Indices LGCI). The Consumer Price Index (CPI) was excluded. Research based upon the indices commonly used by Councils concludes that the CPI is not a historically accurate reflection of the costs of infrastructure projects.

The Productivity Price Index (PPI) and the Local Government Cost Indices LGCI) are relevant to the pricing of construction of infrastructure assets as they are designed to measure the change in the price of outputs (e.g. buildings) and the inputs (e.g. materials used) acquired by Councils in a given period and compares these with the price of the same set in the base period.

The application of indexation allows the value of the assets to be determined in today's costs and marketplace.

The Productivity Price Index data was sourced from the Australian Bureau of Statistics (PPI- ABS Index 6427.0).

For the ten years from 1997 to 2011 there was a averaged movement in the PPI index of approximately 4.62 per cent per annum.

With regard to the Local Government Cost Index we referred to the Local Government Association of Queensland (LGAQ) Report 'Local Government Cost Pressures 2010'. This report states that the Local Government Cost Index (LGCI) provides an aggregated picture of cost movements at the state level. The mix of construction and non-construction activity varies from Council to Council.

With reference to the LGCI for the six year period of 2004 to 2010 the report provides an average LGCI of 4.3 per cent per annum. The report also indicates that a similar average cost increase is expected for the proceeding period.

Following review the PPI and LGCI and annualising the average increase over the given period, it was determined that a midpoint of 4.5 per cent per annum (rounded) is an appropriate indexation factor.

The slightly higher indexation figure of 5 per cent per annum has been adopted to account for the estimated additional costs that are typically incurred in the construction of infrastructure projects in remote areas, such as Boigu and Saibai Islands.

All estimates have been based upon simultaneous construction on a green field site. No allowance has been made for the removal of existing infrastructure or temporary reinstatement of roads, stormwater or sewerage during the construction works.

Additional costs that are not accounted for in this report, could be incurred if construction works were to be carried out separately or existing infrastructure is required to be removed from site.

## 7.1 Sewer

The opinion of probable construction costs for the sewerage infrastructure on Boigu and Saibai has been estimated based on recent construction contract prices for the construction of similar works in the Torres Strait region.

Estimates for the OPCC have been based on:

- Poruma Sewerage Scheme (tendered 2012),
- Mabuiag Sewerage Scheme (constructed 2010),
- Warraber Sewerage Scheme (constructed 2010)
- Masig Sewerage Schemes (constructed 2009)

## 7.2 Water

The opinion of probable construction costs for the water infrastructure on Boigu and Saibai has been estimated based on recent construction contract prices for the construction of similar works in the Torres Strait Region.

Where possible prices have been based on the Commonwealth and State Government Major Infrastructure Program Stage 4B works which included the replacement and construction of additional water infrastructure on Mabuiag, Hammond & Saibai Islands. These works tendered and completed in 2011.

Some pricing for water assets has also been based on the Island Coordinating Council Infrastructure Support Unit Asset Database (2005). Construction costs in this database are now over 7 years old and have been adjusted by the indexation figure of 5 % per annum.

## 7.3 Roads

The opinion of probable construction costs for the existing roads on Boigu and Saibai is based on the replacement costs as detailed in the TSIRC Asset database.

The cost estimate in this database compares favourably to rates for other roadwork's constructed in the the Torres Strait as part of the Heavy Equipment Management and Training Program and Major Infrastructure Program.

## 7.4 Stormwater \ Drainage

The opinion of probable construction costs for the stormwater infrastructure on Boigu and Saibai islands has been estimated using rates based on similar works undertaken as part of the Heavy Equipment Management and Training Program and Major Infrastructure Program.

## 7.5 Marine Facilities

The Opinion of Probable Construction Costs for Marine Facilities on Boigu and Saibai has been determined from construction estimated included in the AECOM report titled "The Inundation Management of Saibai Boigu and Iama Islands (Nov 2011).

A rate per linear metre for the construction of seawalls has been determined from this report with this rate then applied to the existing infrastructure.

Other marine facilities have been estimated from the TSIRC Asset Database with the prices adjusted by the indexation figure of 5% per annum.

## 7.6 Airport

Opinion of probable construction costs for the Airport Facilities on Boigu and Saibai have been based on the TSIRC Asset Database with the prices adjusted by the indexation figure of 5% per annum.

The prices in the TSIRC Asset Database have been cross checked against similar works carried out by the Heavy Equipment Management and Training Program on Warraber and Iama Island.

## 7.7 Buildings

For the purposes of this report a standard figure of $550,000 has been adopted for the replacement value of each house.

This figure has been based on prices in the TSIRC Asset Database and prices received by Black & More for works of a similar nature.

Whilst it is recognised that the construction type, quality and size of each house will vary this figure has been adopted as a replacement cost for an average house in the community.

Where possible the costs for other buildings have been based on the information provided in the TSIRC Asset Database. For instances where this is not possible, pricing for other non-residential buildings has been determined based on a nominal rate of $4,000 per square metre.

## 7.8 Ergon

Black & More contacted Ergon Energy regarding the replacement cost of their infrastructure on Boigu and Saibai. Ergon have provided estimated prices for the replacement of their infrastructure in both communities as detailed in Appendix 1 & 2 of this report.

## 7.9 Telstra

Black & More contracted Telstra and requested opinion of probable construction costs for their existing infrastructure on each Island.

Telstra advised that this information was considered confidential and could not be provided to an external party. Accordingly Black & More have estimated the replacement costs based on the length of Telstra cabling as obtained in the relevant Sustainable Land Use Plans and prices received from Telstra and other contractors for similar works in Cape York. A remote area factor of 75% has been applied to these costs to reflect the higher cost of delivering infrastructure on Boigu and Saibai Island.

## 7.10 Waste & Landfill Facilities

The opinion of probable construction costs for the Waste and Landfall Facilities on Boigu & Saibai has been based on similar works carried out under the Major Infrastructure Program in 2009.

The construction prices have been adjusted by the indexation figure of 5% per annum.

# 8 BOIGU ISLAND – ASSET REPLACEMENT VALUES

| Infrastructure Asset | Opinion of Probable Construction Costs Boigu ($) |
|---|---|
| Sewer | 9,947,540 |
| Water | 8,386,570 |
| Roads | 6,817,000 |
| Stormwater \ Drainage | 764,300 |
| Marine Facilities | 5,265,000 |
| Airport | 2,875,000 |
| Buildings | 53,221,120 |
| Ergon | 11,000,000 |
| Telstra | 4,634,056 |
| Waste & Landfill Facilities | 402,000 |
| **TOTAL** | **103,312,586** |

Table 3 Boigu Island Opinion of Probable Construction Costs

# 9 SAIBAI ISLAND – ASSET REPLACEMENT VALUES

| Infrastructure Asset | Opinion of Probable Construction Costs Saibai ($) |
|---|---|
| Sewer | 11,131,030 |
| Water | 8,303,464 |
| Roads | 13,853,700 |
| Stormwater \ Drainage | 682,716 |
| Marine Facilities | 7,473,000 |
| Airport | 2,902,250 |
| Buildings | 63,772,300 |
| Ergon | 12,000,000 |
| Telstra | 5,294,320 |
| Waste & Landfill Facilities | 499,000 |
| **TOTAL** | **125,911,780** |

Table 4 Saibai Island Opinion of Probable Construction Costs

# 10 OPINION OF PROBABLE CONSTRUCTION COSTS FOR PROVISION OF BULK FILL TO BOIGU OR SAIBAI ISLAND

Pioneer North Queensland (Cairns based quarry) have provided a price for the supply and delivery (to barge) of select fill material.

Seaswift have quoted a daily rate for the hire of the Colossus Barge. This barge is the largest barge (dumb) in the Seaswift fleet with a carrying capacity of 1500 tonne.

Seaswift have estimated that a return trip to Boigu or Saibai Island will take around 12 days.

Additional port fees will be payable on departure.

The total cost for the supply and transport of 1500 tonnes of select fill to Boigu or Saibai Island is $210,300. This equates to a rate of $140 per tonne or approximately $380 per $m^3$

A detailed breakdown of these prices is contained in Appendix 3.

It is noted that this price is based on uncompacted volumes and does not include an allowance for transportation of the material to the worksite once it has been delivered to Boigu and Saibai.

# APPENDIX 1
## Boigu Island Asset Replacement Costs

Project: **Boigu & Saibai Asset Replacement** **Project No. 6994**

Client: **James Cook University**

## Boigu Asset Replacement Schedule

**Revision No. 1**

| | Description | Amount $ |
|---|---|---|
| **SUMMARY OF ASSET PRICES** | | |
| 1 | SEWER | $9,947,540 |
| 2 | WATER | $8,386,570 |
| 3 | ROAD | $6,817,000 |
| 4 | STORMWATER / DRAINAGE | $764,300 |
| 5 | MARINE FACILITIES | $5,265,000 |
| 6 | AIRPORT | $2,875,000 |
| 7 | BUILDINGS | $53,221,120 |
| 8 | ERGON | $11,000,000 |
| 9 | TELSTRA | $4,634,056 |
| 10 | WASTE AND TIP FACILITIES | $402,000 |
| **TOTAL VALUE OF INFRASTRUCTURE (Excluding GST)** | | **$103,312,586** |
| **GST** | | **$10,331,259** |
| **TOTAL VALUE OF INFRASTRUCTURE (Including GST)** | | **$113,643,845** |

**Note: All Rates and Amounts are Exclusive of GST**

Project: **Boigu & Saibai Asset Replacement** **Project No. 6994**

Client: **James Cook University**

## Boigu Asset Replacement Schedule

**Revision No. 1**

| Item | Description | Qty | Unit | Rate $ | Amount $ |
|---|---|---|---|---|---|
| **1** | **SEWER** | | | | |
| 1.01 | Site Establishment, Engineering and Misc Fees | 1 | Item | | 3,350,000 |
| 1.02 | House Connections | 62 | No. | 1,110 | 68,820 |
| 1.03 | Sewer Reticulation | | | | |
| | (a) 0 > 3 deep 150 dia PVC sewer main | 1,840 | m | 400 | 736,000 |
| 1.04 | Manholes | | | | |
| | (a) 1050 dia. x min. 1500 deep | 45 | No. | 8,470 | 381,150 |
| | (b) 1050 dia. x min. 1500 deep Screening | 1 | No. | 18,290 | 18,290 |
| | (c) Overflow | 2 | No. | 16,640 | 33,280 |
| 1.05 | Pump stations | 1 | Item | | 400,000 |
| 1.06 | Rising Main | 1 | Item | | 170,000 |
| 1.07 | Sewer Treatment Plant | 1 | Item | | 4,500,000 |
| 1.08 | Operator buildings | 1 | Item | | 250,000 |
| 1.09 | Outfalls | 1 | Item | | 40,000 |
| | **SEWER TOTAL** | | | | **9,947,540** |

Project: **Boigu & Saibai Asset Replacement** **Project No. 6994**
Client: **James Cook University**

## Boigu Asset Replacement Schedule

**Revision No. 1**

| Item | Description | Qty | Unit | Rate $ | Amount $ |
|---|---|---|---|---|---|
| **2** | **WATER** | | | | |
| 2.01 | Site Establishment, Engineering and Misc Fees | 1 | Item | | 1,600,000 |
| 2.03 | Operator buildings | 1 | Item | | 50,250 |
| 2.04 | Storage Lagoon & Treatment Facilities | 1 | Item | | 3,800,000 |
| 2.05 | Sea Water Intake | 1 | Item | | 362,100 |
| 2.06 | Desalination plant - Reverse Osmosis based | 1 | Item | | 1,666,020 |
| 2.07 | Reticulation Mains | | | | |
| | (a) 80 dia PVC | 1,900 | m | 478 | 908,200 |
| | **WATER TOTAL** | | | | **8,386,570** |

Project: **Boigu & Saibai Asset Replacement** **Project No. 6994**

Client: **James Cook University**

**Boigu Asset Replacement Schedule** **Revision No. 1**

| Item | Description | Qty | Unit | Rate $ | Amount $ |
|---|---|---|---|---|---|
| **3** | **ROAD** | | | | |
| 3.01 | Site Establishment, Engineering and Misc Fees | 1 | Item | | 450,000 |
| 3.02 | Roads - Fibre Reinforced Concrete | 1 | Item | | 6,367,000 |
| 3.03 | Unsealed Roads and Tracks | 1 | Item | | 500,000 |
| | **ROAD TOTAL** | | | | **6,817,000** |

Project: **Boigu & Saibai Asset Replacement** **Project No. 6994**

Client: **James Cook University**

**Boigu Asset Replacement Schedule** **Revision No. 1**

| Item | Description | Qty | Unit | Rate $ | Amount $ |
|---|---|---|---|---|---|
| **4** | **STORMWATER / DRAINAGE** | | | | |
| 4.01 | Site Establishment, Engineering and Misc Fees | 1 | Item | | 400,000 |
| 4.02 | 450 dia RCP pipework and headwalls | 50 | m | 600 | 30,000 |
| 4.03 | 600 dia RCP pipework and headwalls | 340 | m | 700 | 238,000 |
| 4.04 | Concrete Lined Drains | 330 | m | 210 | 69,300 |
| 4.05 | Earth Drains | 300 | m | 90 | 27,000 |
| | **STORMWATER / DRAINAGE TOTAL** | | | | **764,300** |

Project: **Boigu & Saibai Asset Replacement** **Project No. 6994**
Client: **James Cook University**

## Boigu Asset Replacement Schedule

**Revision No. 1**

| Item | Description | Qty | Unit | Rate $ | Amount $ |
|---|---|---|---|---|---|
| **5** | **MARINE FACILITIES** | | | | |
| 5.01 | Site Establishment, Engineering and Misc Fees | 1 | Item | | 800,000 |
| 5.02 | Seawalls | | | | |
| | (a) Sea Walls | 1 | Item | | 2,965,000 |
| | (b) Bund Wall | 1 | Item | | 750,000 |
| 5.03 | Buildings and wharves/jetties | | | | |
| | (a) Finger Pier | 1 | Item | | 690,000 |
| | (b) Concrete Barge Ramp | 1 | Item | | 60,000 |
| | **MARINE FACILITIES TOTAL** | | | | **5,265,000** |

Project: **Boigu & Saibai Asset Replacement** **Project No. 6994**
Client: **James Cook University**

## Boigu Asset Replacement Schedule

**Revision No. 1**

| Item | Description | Qty | Unit | Rate $ | Amount $ |
|---|---|---|---|---|---|
| **6** | **AIRPORT** | | | | |
| 6.01 | Sealed runway | | | | |
| | (a) Airstrip Surface | 1 | Item | | 850,000 |
| | (b) Airstrip Base | 1 | Item | | 1,875,000 |
| 6.02 | Airport buildings | | | | |
| | (a) Airport waiting area | 1 | Item | | 120,000 |
| 6.03 | Airport Lighting | | | | |
| | (a) Solar lighting | 1 | Item | | 30,000 |
| 6.04 | Fencing | 1 | Item | | 59,000 |
| | **AIRPORT TOTAL** | | | | **2,875,000** |

Project: **Boigu & Saibai Asset Replacement** **Project No. 6994**
Client: **James Cook University**
**Boigu Asset Replacement Schedule** **Revision No. 1**

| Item | Description | Qty | Unit | Rate $ | Amount $ |
|---|---|---|---|---|---|
| **7** | **BUILDINGS** | | | | |
| 7.01 | Residential | | | | |
| | (a) Housing (62 houses) | 62 | No. | 550,000 | 34,100,000 |
| 7.02 | School | | | | |
| | (a) Primary School | 1 | Item | | 5,600,000 |
| | (b) Health Care | 1 | Item | | 2,000,000 |
| 7.03 | Church | 1 | Item | | 1,500,000 |
| 7.04 | Community | | | | |
| | (a) Motel | 1 | Item | | 821,000 |
| | (b) Community Hall | 1 | Item | | 1,600,000 |
| | (c) Guesthouse | 1 | Item | | 390,000 |
| | (d) Contractors Housing | 1 | Item | | 340,000 |
| | (e) CEO accommodation | 1 | Item | | 150,000 |
| | (f) Hydroponic Shed | 1 | Item | | 150,000 |
| | (g) Crab shed | 1 | Item | | 96,000 |
| | (h) Generator Shed | 1 | Item | | 13,000 |
| | (j) Freezer Shed | 1 | Item | | 18,000 |
| | (j) Workshop - Mechanical | 1 | Item | | 110,000 |
| | (k) Tyre Shed | 1 | Item | | 47,000 |
| | (l) Carpenters Workshop | 1 | Item | | 490,000 |
| | (m) Sports Oval | 1 | Item | | 250,000 |
| | (n) Sports Court | 1 | Item | | 24,000 |
| | (o) Two door metal shed | 1 | Item | | 72,060 |
| | (p) Chemical Shed | 1 | Item | | 12,000 |
| | (q) Block Shed | 1 | Item | | 110,000 |
| | (r) IBIS Store | 1 | Item | | 2,000,000 |
| | (s) Fuel Bowsers | 1 | Item | | 80,000 |
| 7.05 | Customs and municipal administration | | | | |
| | (a) Council Office | 1 | Item | | 2,822,000 |
| | (b) Police Station | 1 | Item | | 340,000 |
| | (c) SES Shed | 1 | Item | | 86,060 |
| | **BUILDINGS TOTAL** | | | | **53,221,120** |

Project: **Boigu & Saibai Asset Replacement** **Project No. 6994**

Client: **James Cook University**

## Boigu Asset Replacement Schedule

**Revision No. 1**

| Item | Description | Qty | Unit | Rate $ | Amount $ |
|---|---|---|---|---|---|
| **8** | **ERGON** | | | | |
| 8.01 | Power lines poles and lights | 1 | Item | | 1,000,000 |
| 8.02 | Buildings & Generators | 1 | Item | | 10,000,000 |
| | **ERGON TOTAL** | | | | **11,000,000** |

Project: **Boigu & Saibai Asset Replacement** **Project No. 6994**
Client: **James Cook University**

## Boigu Asset Replacement Schedule

**Revision No. 1**

| Item | Description | Qty | Unit | Rate $ | Amount $ |
|---|---|---|---|---|---|
| **9** | **TELSTRA** | | | | |
| 9.01 | Service lines | 1,289 | m | 104 | 134,056 |
| 9.02 | Buildings, Telstra boxes and communication equipment | 1 | Item | | 4,500,000 |
| | **TELSTRA TOTAL** | | | | **4,634,056** |

Project: **Boigu & Saibai Asset Replacement** **Project No. 6994**

Client: **James Cook University**

**Boigu Asset Replacement Schedule** **Revision No. 1**

| Item | Description | Qty | Unit | Rate $ | Amount $ |
|---|---|---|---|---|---|
| **10** | **WASTE AND TIP FACILITIES** | | | | |
| 10.02 | Wash-down slab | 1 | Item | | 27,000 |
| 10.03 | Landfill bund | 1 | Item | | 75,000 |
| 9.04 | Landfill facility | 1 | Item | | 300,000 |
| | **WASTE AND TIP FACILITIES TOTAL** | | | | **402,000** |

Project: **Boigu & Saibai Asset Replacement** **Project No. 6994**
Client: **James Cook University**

## Boigu Asset Replacement Schedule

**Revision No. 1**

**REVISION STATUS**

| Rev. | Associated Drgs | Description | Date | Reviewed |
|---|---|---|---|---|
| 1 | | | 23/4/12 | GOB |

# APPENDIX 2
## Saibai Island Asset Replacement Costs

Project: **Boigu & Saibai Asset Replacement** **Project No. 6994**
Client: **James Cook University**

**Saibai Asset Replacement Schedule** **Revision No. 1**

| Description | | Amount $ |
|---|---|---|
| **SUMMARY OF ASSET PRICES** | | |
| 1 | SEWER | 11,131,030 |
| 2 | WATER | 8,303,464 |
| 3 | ROAD | 13,853,700 |
| 4 | STORMWATER / DRAINAGE | 682,716 |
| 5 | MARINE FACILITIES | 7,473,000 |
| 6 | AIRPORT | 2,902,250 |
| 7 | BUILDINGS | 63,772,300 |
| 8 | ERGON | 12,000,000 |
| 9 | TELSTRA | 5,294,320 |
| 10 | WASTE AND LANDFILL FACILITIES | 499,000 |
| **TOTAL VALUE OF INFRASTRUCTURE (Excluding GST)** | | **125,911,780** |
| **GST** | | **12,591,178** |
| **TOTAL VALUE OF INFRASTRUCTURE (Including GST)** | | **138,502,958** |

**Note: All Rates and Amounts are Exclusive of GST**

Project: **Boigu & Saibai Asset Replacement** **Project No. 6994**
Client: **James Cook University**

## Saibai Asset Replacement Schedule

**Revision No. 1**

| Item | Description | Qty | Unit | Rate $ | Amount $ |
|---|---|---|---|---|---|
| **1** | **SEWER** | | | | |
| 1.01 | Site Establishment, Engineering and Misc Fees | 1 | Item | | 3,345,000 |
| 1.02 | Sewer Reticulation | | | | |
| | (a) 150 dia. PVC Sewer pipe | 2,250 | m | 400 | 900,000 |
| | (b) 225 dia. PVC Sewer pipe | 950 | m | 450 | 427,500 |
| 1.03 | Manholes | | | | |
| | (a) 1050 dia. x min. 1500 deep | 54 | No. | 8,470 | 457,380 |
| | (b) 1050 dia. x min. 1500 deep Screening | 3 | No. | 18,290 | 54,870 |
| | (c) Overflow | 2 | No. | 16,640 | 33,280 |
| 1.04 | Pump stations | | | | |
| | (a) Pump Station 1 | 1 | Item | | 400,000 |
| | (b) Pump Station 2 | 1 | Item | | 400,000 |
| | (c) Pump Station 3 | 1 | Item | | 400,000 |
| 1.05 | Rising Main | 1 | Item | | 148,000 |
| 1.06 | Sewer Treatment Plant | 1 | Item | | 4,500,000 |
| 1.07 | Operator buildings | | | | |
| | (a) Works Shed | 1 | Item | | 25,000 |
| 1.08 | Outfalls | 1 | Item | | 40,000 |
| | **SEWER TOTAL** | | | | **11,131,030** |

Project: **Boigu & Saibai Asset Replacement** **Project No. 6994**
Client: **James Cook University**
## Saibai Asset Replacement Schedule
**Revision No. 1**

| Item | Description | Qty | Unit | Rate $ | Amount $ |
|---|---|---|---|---|---|
| **2** | **WATER** | | | | |
| 2.01 | Site Establishment, Engineering and Misc Fees | 1 | Item | | 1,600,000 |
| 2.02 | Operator buildings / Shed | 1 | Item | | 50,000 |
| 2.03 | Storage Lagoon & Treatment Facilities | 1 | Item | | 3,900,000 |
| 2.04 | Pump stations | | | | |
| | (a) Pump Station 1 | 1 | Item | | 660,000 |
| | (b) Pump Station 2 | 1 | Item | | 500,000 |
| 2.05 | Reticulation Mains | | | | |
| | (a) 80 dia PVC | 3,272 | m | 487 | 1,593,464 |
| | **WATER TOTAL** | | | | **8,303,464** |

Project: **Boigu & Saibai Asset Replacement** **Project No. 6994**

Client: **James Cook University**

## Saibai Asset Replacement Schedule

**Revision No. 1**

| Item | Description | Qty | Unit | Rate $ | Amount $ |
|---|---|---|---|---|---|
| **3** | **ROAD** | | | | |
| 3.01 | Site Establishment, Engineering and Misc Fees | 1 | Item | | 850,000 |
| 3.02 | Roads - Fibre Reinforced Concrete | 1 | Item | | 13,003,700 |
| | **ROAD TOTAL** | | | | **13,853,700** |

Project: **Boigu & Saibai Asset Replacement** **Project No. 6994**
Client: **James Cook University**

**Saibai Asset Replacement Schedule** **Revision No. 1**

| Item | Description | Qty | Unit | Rate $ | Amount $ |
|---|---|---|---|---|---|
| **4** | **STORMWATER / DRAINAGE** | | | | |
| 4.01 | Site Establishment, Engineering and Misc Fees | 1 | Item | | 400,000 |
| 4.02 | 600 dia RCP pipework and headwalls | 90 | Item | 600 | 54,000 |
| 4.03 | 900 dia RCP pipwork and headwalls | 20 | m | 1,400 | 28,000 |
| 4.04 | 1200 x 750 RCBC | 54 | m | 3,309 | 178,666 |
| 4.05 | Concrete lined drains | 105 | m | 210 | 22,050 |
| | **STORMWATER / DRAINAGE TOTAL** | | | | **682,716** |

Project: **Boigu & Saibai Asset Replacement** **Project No. 6994**
Client: **James Cook University**
## Saibai Asset Replacement Schedule
**Revision No. 1**

| Item | Description | Qty | Unit | Rate $ | Amount $ |
|---|---|---|---|---|---|
| **5** | **MARINE FACILITIES** | | | | |
| 5.01 | Seawalls | | | | |
| | (a) Sea Walls | 1 | Item | | 4,450,000 |
| | (b) Bund Wall | 1 | Item | | 1,000,000 |
| 5.02 | Site Establishment, Engineering and Misc Fees | 1 | Item | | 650,000 |
| 5.03 | Buildings and wharves/jetties | | | | |
| | (a) Wharf Shed | 1 | Item | | 18,000 |
| | (b) Finger Pier | 1 | Item | | 690,000 |
| | (c) Barge Ramp | 1 | Item | | 65,000 |
| | (d) Marine Channel | 1 | Item | | 600,000 |
| | **MARINE FACILITIES TOTAL** | | | | **7,473,000** |

Project: **Boigu & Saibai Asset Replacement** **Project No. 6994**

Client: **James Cook University**

## Saibai Asset Replacement Schedule

**Revision No. 1**

| Item | Description | Qty | Unit | Rate $ | Amount $ |
|---|---|---|---|---|---|
| **6** | **AIRPORT** | | | | |
| 6.01 | Sealed runway | | | | |
| | (a) Airstrip Surface | 1 | Item | | 902,500 |
| | (b) Airstrip Base | 1 | Item | | 1,858,750 |
| 6.02 | Airport buildings | | | | |
| | (a) Terminal Shelter | 1 | Item | | 20,000 |
| | (b) Apron Shed | 1 | Item | | 37,000 |
| 6.04 | Airport Lighting | | | | |
| | (a) Solar lighting x 6 | 1 | Item | | 30,000 |
| 6.03 | Fencing | 1 | Item | | 54,000 |
| | **AIRPORT TOTAL** | | | | **2,902,250** |

Project: **Boigu & Saibai Asset Replacement** **Project No. 6994**
Client: **James Cook University**

## Saibai Asset Replacement Schedule

**Revision No. 1**

| Item | Description | Qty | Unit | Rate $ | Amount $ |
|---|---|---|---|---|---|
| **7** | **BUILDINGS** | | | | |
| 7.01 | Residential | | | | |
| | (a) Housing (88 houses) | 88 | No. | 550,000 | 48,400,000 |
| 7.02 | School | | | | |
| | (a) Primary School | 1 | Item | | 5,000,000 |
| | (b) Health Care Centre | 1 | Item | | 2,000,000 |
| 7.03 | Church | 1 | Item | | 1,500,000 |
| 7.04 | Community | | | | |
| | (a) Community Hall | 1 | Item | | 771,300 |
| | (b) Childcare Centre | 1 | Item | | 855,000 |
| | (c) Bistro | 1 | Item | | 400,000 |
| | (d) Former Childcare Centre | 1 | Item | | 18,000 |
| | (e) Workshop | 1 | Item | | 200,000 |
| | (f) 2 transp. & awning | 1 | Item | | 11,000 |
| | (g) 3 Gazebo's Opp. Council Office | 1 | Item | | 22,000 |
| | (h) Shed - Opp. Ibis Store | 1 | Item | | 36,000 |
| | (i) Transportable Awning - Ausco | 1 | Item | | 49,000 |
| | (j) Sheds - Gym & Store | 1 | Item | | 37,000 |
| | (k) Guesthouse Accommodation | 1 | Item | | 624,000 |
| | (l) Basketball Court | 1 | Item | | 73,000 |
| | (m) IBIS Store | 1 | Item | | 2,000,000 |
| | (n) Ausco Transportable Awning | 1 | Item | | 30,000 |
| | (o) Fuel Bowsers | 1 | Item | | 80,000 |
| 7.05 | Customs and municipal administration | | | | |
| | (a) Council Office | 1 | Item | | 1,145,000 |
| | (b) CDEP shed | 1 | Item | | 43,000 |
| | (c) Builders Garage | 1 | Item | | 13,000 |
| | (d) Builders Awning | 1 | Item | | 69,000 |
| | (e) Builders Shed | 1 | Item | | 63,000 |
| | (f) Shed - Water Pump | 1 | Item | | 33,000 |
| | (g) Police Station | 1 | Item | | 300,000 |
| | **BUILDINGS TOTAL** | | | | **63,772,300** |

Project: **Boigu & Saibai Asset Replacement** **Project No. 6994**
Client: **James Cook University**

**Saibai Asset Replacement Schedule** **Revision No. 1**

| Item | Description | Qty | Unit | Rate $ | Amount $ |
|---|---|---|---|---|---|
| **8** | **ERGON** | | | | |
| 8.01 | Power lines and poles | 4,500 | Item | | 2,000,000 |
| 8.02 | Buildings & Generators | 1 | Item | | 10,000,000 |
| | **ERGON TOTAL** | | | | **12,000,000** |

Project: **Boigu & Saibai Asset Replacement** **Project No. 6994**
Client: **James Cook University**
**Saibai Asset Replacement Schedule** **Revision No. 1**

| Item | Description | Qty | Unit | Rate $ | Amount $ |
|---|---|---|---|---|---|
| **9** | **TELSTRA** | | | | |
| 9.01 | Service lines | 2,830 | m | 104 | 294,320 |
| 9.02 | Buildings, Telstra Boxes and communication equipment | 1 | No. | | 5,000,000 |
| | **TELSTRA TOTAL** | | | | **5,294,320** |

Project: **Boigu & Saibai Asset Replacement** **Project No. 6994**

Client: **James Cook University**

**Saibai Asset Replacement Schedule** **Revision No. 1**

| Item | Description | Qty | Unit | Rate $ | Amount $ |
|---|---|---|---|---|---|
| **10** | **WASTE AND LANDFILL FACILITIES** | | | | |
| 9.01 | Fencing | 1 | Item | | 32,000 |
| 9.02 | Wash-down slab | 1 | Item | | 27,000 |
| 9.03 | Landfill bund | 1 | Item | | 90,000 |
| 9.04 | Landfill facility | 1 | Item | | 350,000 |
| | **WASTE AND LANDFILL FACILITIES TOTAL** | | | | **499,000** |

Project: **Boigu & Saibai Asset Replacement** **Project No. 6994**
Client: **James Cook University**
**Saibai Asset Replacement Schedule** **Revision No. 1**

**REVISION STATUS**

| Rev. No. | Associated Drgs | Description | Date | Reviewed |
|---|---|---|---|---|
| 1 | | | 23/04/12 | GOB |

# APPENDIX 3
## Costs for Provision of Bulk Fill

Project: **Boigu & Saibai Asset Replacement** **Project No. 6994**
Client: **James Cook University**

## Saibai and Boigu Shipping Fees Schedule

**Revision No. 1**

| Description | | Amount $ |
|---|---|---|
| **SUMMARY OF SHIPPING PRICES** | | |
| 1 | BARGE HIRE | 187,500 |
| 2 | PORT FEES | 6,075 |
| 3 | FILL (Pioneer NQ) | 16,725 |
| **TOTAL COST OF SHIPPING (Excluding GST)** | | **210,300** |
| **GST** | | **21,030** |
| **TOTAL COST OF SHIPPING (Including GST)** | | **231,330** |

**Note: All Rates and Amounts are Exclusive of GST**

Project: **Boigu & Saibai Asset Replacement** **Project No. 6994**

Client: **James Cook University**

## Saibai and Boigu Shipping Fees Schedule

**Revision No. 1**

| Item | Description | Qty | Unit | Rate $ | Amount $ |
|---|---|---|---|---|---|
| **1** | **BARGE HIRE** | | | | |
| 1.01 | Hire of Colossus Barge (1500 tonne capacity) | 12 | Day | 15,625 | 187,500 |
| | **BARGE HIRE TOTAL** | | | | **187,500** |

| Item | Description | Qty | Unit | Rate $ | Amount $ |
|---|---|---|---|---|---|
| **2** | **PORT FEES** | | | | |
| 2.01 | Port fee ( Charge by the tonne) | 1,500 | tonne | 4.05 | 6,075 |
| | **PORT FEES TOTAL** | | | | **6,075** |

| Item | Description | Qty | Unit | Rate $ | Amount $ |
|---|---|---|---|---|---|
| **3** | **FILL (Pioneer NQ)** | | | | |
| 3.01 | Select Fill | 1,500 | tonne | 11.15 | 16,725 |
| | **FILL TOTAL** | | | | **16,725** |

**NOTE:** 1 cubic metre of fill is equivalent of approximately 2.7 tonnes of fill material

**REVISION STATUS**

| Rev. | Associated Drgs | Description | Date | Reviewed |
|---|---|---|---|---|
| 1 | | | 23/4/12 | GOB |