

20 December 2010

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5-C1930.00

Dear Kate

### **Baring Head – Inspection of World War II Structures**

We write with regard to the above inspection works, undertaken in accordance with the request by Kate Zwartz of Greater Wellington Regional Council in an email dated 17 November 2010.

The inspection of the structures was undertaken by Darren Goodall of our Wellington Office on the morning of 16 December 2010. Steve Edwards, a Principal Ranger of Greater Wellington Council, accompanied the inspection and provided vehicular access to the site, which is to the north of the outlet of the Wainuinomata River and in close proximity to the Baring Head Lighthouse.



Aerial view showing location of World War II Structures

## **Executive Summary**

This letter report describes the findings of the inspection of the three structures and provides recommendations for ensuring the immediate safety and durability of the buildings. In accordance with the scope agreed, the inspection was of a visual nature only and the recommendations / conclusions are therefore limited to items that could be identified reasonably at the time of the inspection.

In summary, Opus advises that the two reinforced concrete accommodation / storage / communication buildings are in reasonable condition, and subject to appropriate repair work, can be made suitable for controlled access by members of the general public.

The separate observation bunker, which overlooks the Baring Head Lighthouse, has been subject to major deterioration, principally to the roof / and cantilever support structure. Major works, including the removal of the existing roof and support beams, would be required to allow safe access.

It is important to note that any work undertaken to the structures will need to take into account the advice and requirements of the New Zealand Historic Places Trust.

### **1 General Information**

The three structures inspected were constructed during the Second World War as a means of observing potential enemy threats approaching from south and west of the Wainuiomata coast.

Greater Wellington Regional Council are opening a significant part of the Baring Head area as a scenic reserve in February 2011. The inspection therefore determined the potential future suitability of allowing access to members of the general public.

Three structures were inspected in total. The first two buildings overlook the Wainuiomata Valley and it is likely that these would have been used for accommodation, communication and storage purposes. The third structure was an observation bunker, which affords excellent views to the west and south of Baring Head.

No historical information was provided for the structures. In accordance with the scope agreed, the inspection was limited to a visual inspection only i.e. no intrusive investigation was undertaken. As all of the structures are potentially deemed to be of historic significance, any works recommended within this report would be subject to the review and approval by the relevant Authority e.g. New Zealand Historic Places Trust.

As no designated access routes are available at present, the structures were reached via the use of a four-wheel drive vehicle driven by a Principal Ranger of Greater Wellington Regional Council.

All of the structures inspected have been surrounded by a wooden post and steel wire fence, in order to indicate that these areas are currently deemed as unsafe for general access (and to prevent any access by livestock).

## 2 Inspection

The inspection was undertaken by Darren Goodall, a Senior Structural Engineer from Opus during the morning of 16 December 2010, between the hours of 10.00am and 12.00pm approximately. The inspection was also attended by Steve Edwards of Greater Wellington Regional Council. The weather during the inspection was bright and warm.

### 2.1 Accommodation / Storage / Communication Buildings

These buildings are both single storey cast in situ reinforced concrete structures, incorporating a reinforced concrete roof.



Front view of reinforced concrete buildings

The buildings are located immediately adjacent to each other, and are likely to have served as accommodation / storage and communication facilities for the military personnel stationed at this location.

A part buried concrete water storage tank, incorporating a concrete circular lid, is located nearby to these buildings (see **Photo 1** to the rear of this report). This was not inspected during the site visit.

### 2.2 Structure 1

This structure has a floor plan of approximately 4.0m wide x 3.2m deep, with typical wall thickness of 250mm. The sloping roof consists of an cast in situ reinforced concrete slab of thickness 165mm, which overhangs the walls by approximately 150mm.

The thickness of the walls, together with the presence of steel shuttering to the single window (see **Photo 2**), indicates that this structure may have been designed to withstand a form of blast loading.

The external faces of the building were found to be in relatively good condition (especially with regard to its age and exposed location), with minor loss to the concrete rendering around the doorway. The building shows signs of neglect internally.

There is evidence of some graffiti, although the remote nature of the building means that it remains relatively unscathed from human interference.

The main defect to the building is a longitudinal crack in the roof soffit which runs the entire length of the roof (from front to back) – see **Photo 4**. There is no evidence of distress / sagging to the slab, which indicates that it continues to be supported correctly by the walls. It is likely that this crack is well-established and therefore does not indicate a recent form of localised failure.

As the roof slopes slightly rearward, rainwater has penetrated the crack and this has resulted in unsightly staining to the rear wall (see **Photo 3**). The roof crack and rear wall are damp to the touch, and this is an indication of ongoing water ingress into the roof slab matrix from above.

There is spalling evident around the internal edge of the doorway and window, with some exposed reinforcement exhibiting corrosion (round bars 1/4" or 6.4mm diameter) – see **Photo 5**.

A grout repair was noted running around all of the internal walls just below roof soffit level (see **Photo 6**). This feature is not evident to the external face of the building. It is possible that a rebate was cut into the walls to accommodate a cable / duct of some kind during the operational life of the building, although the rebate is not cut in a straight horizontal line as one would expect. There is cracking along the line of the grout repair, although this is probably due to shrinkage and is not considered as being structural in nature.

Although the steel door is no longer attached to the door opening, it has not been removed from the site and lies on the ground to the front of the structure – see **Photo 7**. Both the door and window shutters are in an advanced state of corrosion.

The roof was found to be in good condition (see **Photo 8**). However, a crack, running from front to back was noted – this corresponds with the crack observed to the internal roof soffit.

## 2.3 Structure 2

This structure, sited immediately adjacent to the south of Structure 1, has a floor plan of approximately 5.3m wide x 3.15m deep, with a typical wall thickness of 200mm. It appears to be constructed in a less robust manner to Structure 1, with multiple windows / openings to the four walls. The roof is of similar construction to Structure 1. The building is in reasonable condition.

The walls of Structure 2 have been constructed in a 'rough-cast' manner, with wooden horizontally-secured planks used as formwork. There is no evidence of any rendering being applied to the external walls of Structure 2, and this has contributed to the deterioration of the external walls. Spalling and exposed reinforcement is present in several locations, with points of localised failure typically emanating along the line of the rough-cast formwork edges (see **Photos 9 and 11**).

The roof is in good condition, with no evidence of failure or distress to either the external or internal faces (see **Photo 10**).

The internal walls exhibit vertical formwork lines, as per the external faces. However, spalling is less evident due to their less exposed nature (see **Photos 12 and 13**).

The main defect to this structure was found in the lower right rear corner of the walls. The external face was found to be cracked, and this effect has been replicated to the internal face, with extensive spalling and exposure of reinforcement (see **Photos 14 and 15**). Further investigation would be required to determine the reason for this defect, although the most likely causes would be:

- a) Damage through some form of impact;
- b) Localised movement at the base of the wall;
- c) Prolonged exposure to water and corrosion / expansion of reinforcement.

The defect appears to be restricted to a small area, and is not replicated elsewhere within the building.

There are wooden strips attached to the roof soffit, which infer that a form of internal partitioning was present in the past. It is possible that this building was used a living / storage area.

## 2.4 Observation Bunker

The observation bunker is located separately to Structures 1 and 2, and faces the Baring Head area to the south and west.

The bunker consists of an cast in situ reinforced concrete partially buried structure. The roof is also cast in reinforced concrete (see **Photos 16 and 17**). In order to provide uninterrupted views, the front half of the bunker roof was originally cast as a cantilever, with steel beams providing roof support.

The nature of the location (direct exposure to a coastline environment), coupled with a lack of upkeep, has unfortunately resulted in the collapse of the cantilever portion of the roof into the bunker at some time in the past (see **Photo 18**). For comparative / illustrative purposes of how the bunker would have looked prior to slab failure, **Photo 19** shows a similar structure at Fort Dorset which remains fully intact.

The failure to the roof has been caused primarily by the rapid deterioration of the cantiliver support steelwork. Extensive corrosion and loss of section to the steel has resulted in the concrete roof failing at the interface with the vertical side walls and rotating downward (**Photo 18** illustrates the failure mode – **Photo 22** shows the unprecedented level of corrosion encountered).

The internal area of the bunker was not accessed, as it was deemed to be too dangerous. However, it was possible to view the bunker from the side of the structure. The vertical walls appear to be in reasonable condition, and the original mounting position for the binoculars is still present (see **Photo 20**).

The section of the roof slab still intact is supported by the side and rear vertical walls on three sides. The front edge is supported by a steel cross beam that although in an advanced state of corrosion, has not yet failed (see **Photo 21**). This beam was not subject to such direct exposure when compared to the other steel beams, and is therefore still providing support to the roof at this location. In fact, it could be argued that the failure of the cantilever slab has provided additional protection to this beam. The beam is in poor condition and when it eventually fails it is likely that the remaining section of the roof will be subject to further collapse.

### 3 Recommendations

#### 3.1 General

The recommendations presented below relate to work deemed appropriate to the structures to ensure their structural integrity and longevity.

It is important to note that these structures are likely to fall under the remit of the New Zealand Historic Places Trust. As such, any repairs and / or remedial works will need to be undertaken in accordance with their requirements, recommendations and consent. Their advice should also be sought with regard to making the buildings / structures eventually accessible to the general public.

#### 3.2 Structure 1

This structure is in relatively good condition. However, to prevent further deterioration to the structure, the following work should be considered:

##### **Priority**

- a) Undertake remedial work to roof slab to repair and repair / seal longitudinal crack. This will prevent further water ingress into the external area of the structure;
- b) Repair areas of concrete spalling to internal edges of the doors and windows to prevent further deterioration. Apply an approved rust inhibitor, as appropriate, to exposed reinforcing bars exhibiting signs of corrosion.

##### **Desirable**

- a) Repair and reinstate steel door and door frame;
- b) Reinststate area of rendering to front face of structure to prevent further loss;
- c) Clean internal areas to prevent future deterioration e.g. abandoned bird nests, grafitti, debris to floor;
- d) Consider appropriate remedial works to steel shutters, to prevent further corrosion.

### 3.3 Structure 2

This structure is in reasonable condition. To prevent further deterioration to the structure, the following work should be considered:

#### **Priority**

- a) Undertake investigation to determine cause of spalling to rear right corner of wall and undertake suitable repairs to prevent further deterioration.

#### **Desirable**

- a) Repair spalling to external faces, incorporating corrosion inhibitors to exposed steel reinforcement;
- b) Repair isolated areas of spalling to internal walls;
- c) Consider reinstatement of openings / doorways in an appropriate manner, to help protect the building from unnecessary exposure.

### 3.4 Observation Bunker

The roof to this structure has been subject to failure and is currently in a dangerous condition.

#### **Priority**

It is recommended that the following work is undertaken prior to any access being made into the internal area of the bunker:

- a) The collapsed section of roof should be made safe prior as a priority. Complete removal is likely to be required, due to the extreme level of corrosion found within the roof support steelwork;
- b) From a visual observation, it appears that the remaining intact section of roof is supported on one side by a heavily corroded steel beam. It is likely that this beam will have to be replaced, or the remaining section of roof removed, if it is intended to make the bunker accessible to members of the general public.

#### **Desirable**

- a) When viewed from a position of safety, the internal walls and floor of the bunker appear to be in reasonable condition. It is recommended that a further inspection be undertaken when the structure has been made safe to confirm its integrity.

## 4 Conclusion

The recommendations identified within Section 3 of this report are based upon Greater Wellington Regional Council's wish to provide access of the aforementioned structures to members of the general public.

The following is concluded following the inspection:

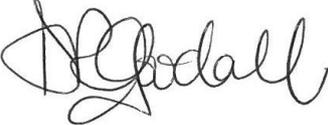
1. We recommend that suitable warning signs are placed onto the existing fences to deter people from straying into the area of the buildings in their current state.
2. Any proposed remedial / repair work should be referred to and undertaken in conjunction with the New Zealand Historic Places Trust, in order to ensure that these important structures are preserved in an appropriate manner. Note that there are likely to be restrictions placed upon the materials and methodology for repair work on these buildings.
3. The items identified as 'priorities' are identified in order to highlight work that should be carried out to each of the buildings to ensure their long term integrity. In the case of the Observation Bunker, the priority items relate to rectifying the partial collapse of the cantilever roof. This defect should be given the most immediate attention, as the structure is currently considered to be in a dangerous condition. We recommend strongly that no access is allowed into this structure until the roof issue is resolved.

The priority issues for the other buildings are not of such immediate concern, but we recommend that they are addressed in the shorter term to prevent further deterioration.

4. The items identified as 'desirable' are included to highlight other items of work that we consider will ensure the continued durability of the buildings.
5. It is important to note that the recommendations within this report are limited to what could be viewed physically at the time of the inspection.

We trust that the enclosed report is in accordance with your requirements. However, if we can be of any further assistance then please do not hesitate to contact either Darren Goodall or Jason Hobman at our Wellington Office.

Yours sincerely

Prepared by: 

Darren Goodall  
**Senior Engineer**

Reviewed by 

Jason Hobman  
**Project Team Leader**

Reviewed / Released by: 

Jason Hobman  
**Project Team Leader**

## Photographs



Photo 1 – View along fenceline from above structures (roofs & water storage tank lid visible in foreground)



Photo 2 – Structure 1: Front elevation of building showing corroded steel shutters to window



Photo 3 – Structure 1: Cracking to in situ reinforced concrete roof and resultant staining to rear wall



Photo 4

Structure 1:

View of cracking to in situ concrete roof.

Spalling to inside edge edge of window.



Photo 5

Structure 1:

View of spalling and exposed reinforcement to internal edge of window.



Photo 6 – Structure 1: View from inside of building looking towards doorway. Evidence of longitudinal grout patch repair along top of walls



Photo 7 – Structure 1: View of steel door removed from structure and lying on ground.



Photo 8 – Structure 1: View of structure roof taken from above and behind.



Photo 9 – Structure 2: Front elevation of building showing multiple openings and evidence of spalling / exposed reinforcement.



Photo 10 – Structure 2: View to roof and rear of building, showing openings to rear and side of structure.



Photo 11 – Structure 2: View to front / side of building showing spalling to front corner and exposed reinforcement



Photo 12 – Structure 2: View of inside of building taken from doorway



Photo 13

Structure 2

View from inside of building taken towards doorway.

Note spalling and exposed reinforcement to inside corner of wall.



Photo 14

Structure 2

View to right rear corner of building exhibiting spalling to concrete.



Photo 15 – Structure 2: View of right rear corner of building showing spalling and exposure of reinforcement .



Photo 16 – Structure 3: View to side of observation bunker showing steel access door and partial collapse to roof.



Photo 17 – Structure 3 - View from observation bunker looking towards Baring Head Lighthouse.



Photo 18 – Structure 3: View of collapsed section of cantilever roof



Photo 19 – **FOR COMPARISON / ILLUSTRATIVE PURPOSES ONLY**  
View of intact roof cantilever slab – Fort Dorset



Photo 20 – Structure 3: View inside bunker showing corrosion / failure  
to cantilever roof support steelwork



Photo 21 – Structure 3: View of bunker roof rear section supported on badly corroded steel beam.



Photo 22 – Structure 3: View showing extensive corrosion to failed section of cantilever roof support steelwork.