Before an Independent Hearing Panel
Appointed by Wellington City Council

In the Matter	of the Resource Management Act 1991
And	
In the Matter	of a Notice of Requirement to designate land for Airport Purposes known as the Main Site NOR.
And	
In the Matter	of a Notice of Requirement to designate land for Airport Purposes known as the East Side Area NOR.

Statement of Evidence of **Philip Robins** for Wellington International Airport Ltd

Dated: 5 May 2021

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INTRODUCTION

Qualifications and Experience

1. My full name is Philip Norman Robins. I am a Technical Director in Beca Limited's (**Beca**) Geotechnical Group based in Wellington.

2. I hold a Bachelor of Science in Civil Engineering from the University of Natal, South Africa (1990) and a master's degree in Civil Engineering, Geotechnical from the University of California at Davis (2000). I have over 30 years' experience in geotechnical and civil engineering and have provided geotechnical advice on a wide variety of civil, commercial, industrial, and land development projects in many parts of New Zealand, Australia and further afield.

3. I am a Member of the New Zealand Geotechnical Society (NZGS) and past Chair of the NZGS. I am a New Zealand Chartered Professional Engineer (CPEng) and a Fellow of Engineering New Zealand (FEngNZ).

4. With respect to the sites subject to the Notices of Requirement (NOR) I have;

   a) Provided geotechnical advice for the Professional Services FY18/19 – AGS Building, Wellington International Airport Ltd, New Zealand, June-August 2018 (Beca Ltd)

   b) Led a geotechnical desktop study for the slope behind the Aviation Ground Services (AGS) building at Wellington Airport Ltd. The desktop study included a qualitative assessment of the rockfall hazard and presented options for slope remediation to provide access to the storage area between the slope and building.

   c) For past 8 years, I have either led or been involved in numerous major infrastructure projects within the greater Wellington area, including Transmission Gully and the MacKays to Peka Peka Expressway (a Road of National Significance). As part of M2PP Expressway Project, I led the design and delivery of the Te Kãkãkura Retaining Wall, a 11m high split retaining wall which was recently awarded a 2017 Concrete Landscape Award Commendation in recognition of "a landscape project outstanding achievement in the advancement of concrete practice in design, construction, rehabilitation or research".

d) Provided geotechnical advice and risk assessments for the ANZAC and Kerry's Wall Slips following closure of the Manawatu Gorge road due to slips in April 2017. I provided geotechnical services which included assessment work to better understand the ongoing risk of slope instability at a site west of the gabion wall known as 'Kerry's Wall' which had failed in April, and survey monitoring suggested was experiencing continued movements.

Code of Conduct Statement

5. While this is not an Environment Court hearing, I nonetheless confirm that I have read the Code of Conduct for Expert Witnesses issued as part of the Environment Court Practice Notes. I agree to comply with the Code and am satisfied that the matters which I address in my evidence are within my field of expertise. I am not aware of any material facts that I have omitted which might alter or detract from the opinions I express in my evidence. I understand that I have an overriding duty to assist the hearing in an impartial manner and that I am not an advocate for the party which has engaged me.

Scope of Evidence

6. I have been asked by Wellington International Airport Limited (**WIAL**) to provide evidence in relation to the likely earthworks and retaining wall options and the viability of the proposed earthworks and retaining solutions. My evidence draws from a desk top study prepared by Beca and summarised in a memorandum[1] which was prepared in response to a further information request from Wellington City Council (**WCC**).

7. In preparing this evidence, I have reviewed the following (in so far as they are relevant to my area of expertise):

   (a) The two NOR and associated Assessment of Environmental Effects (**AEE**) documents;

[1] Beca (2020): WIAL Master Grading Retaining Wall - Geotechnical Desktop Study (Revised), prepared for WIAL, dated 28 September 2020.

(b) Some information provided by WIAL in response to requests issued by Council for each NOR;

(c) Evidence of other WIAL witnesses.;

(d) The Council’s section 42A report;

(e) Submissions that pertain to geotechnical and earthworks issues.

8. My evidence discusses the following:

(a) Overview of the geology of the area;

(b) Ground investigations and likely subsurface conditions;

(c) Proposed retaining wall and earthwork requirements;

(d) Geotechnical and natural hazards \considerations;

(e) Constructability.

EAST SIDE AREA NOR – GEOTECHNICAL CONSIDERATIONS

9. Wellington International Airport Ltd (**WIAL**) released their 2040 Masterplan publicly in October 2019. The Masterplan focuses on development of the airfield and terminal to increase capacity up to 12 million passengers per annum (**MPPA**). The development anticipates moving international operations to a new terminal at the southern end of the existing terminal, and long-term expansion of apron areas east, into land previously occupied by the Miramar Golf Course.

10. Beca Ltd was commissioned by WIAL to develop a 3D Master Grading Model outlining the geometric design of the proposed layout of the proposed apron expansion. The model enables consideration of geometric requirements for finished surface geometries and outlines the anticipated earthworks depths and volumes including impacts on existing trunk services. The proposed eastern expansion requires a cut-volume of approximately 480,000m^3 to reach the finished surface level with an additional cut to of 110,000m^3 required to reach pavement foundation level. I understand that this work would be very unlikely to occur all in one go, as WIAL intends to progressively develop the site over time as demand increases.

11. Concept drawings show the expansion extending to the toe of the hillslopes to the south-east of the existing airfield resulting in cut slopes within landscape buffer zones as indicated in **Figure 1**.

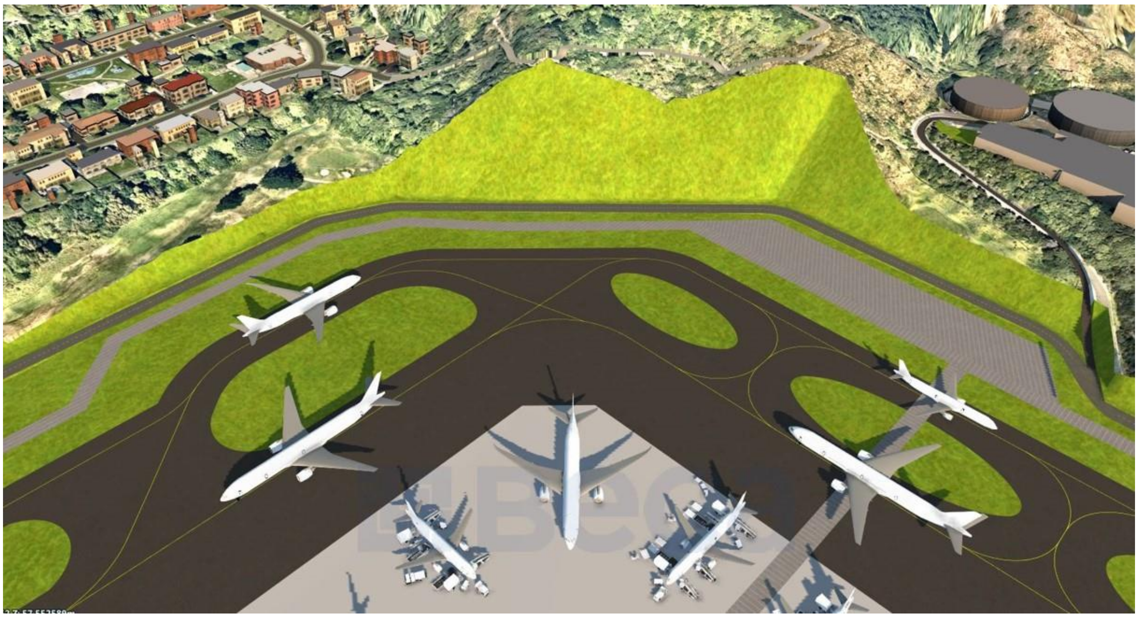

Figure 1: Concept cut slopes along the south east boundary.

12. The cut slopes are likely to be about 500m long overall and consist of three segments: a 80m east-west aligned segment below the Moa Point access road crossing a ~20° northeast facing slope, a 260m southwest-northeast aligned segment along the toe of a northwest facing slope of about 20° to 30°, and a 160m south-north aligned segment.

13. Along the east-west aligned segment the cut slope may be up to about 50m in vertical height. **Figure 2** shows the cut slope which has a proposed batter angle of about 1 Horizontal to 1 Vertical (1H:1V) overall.

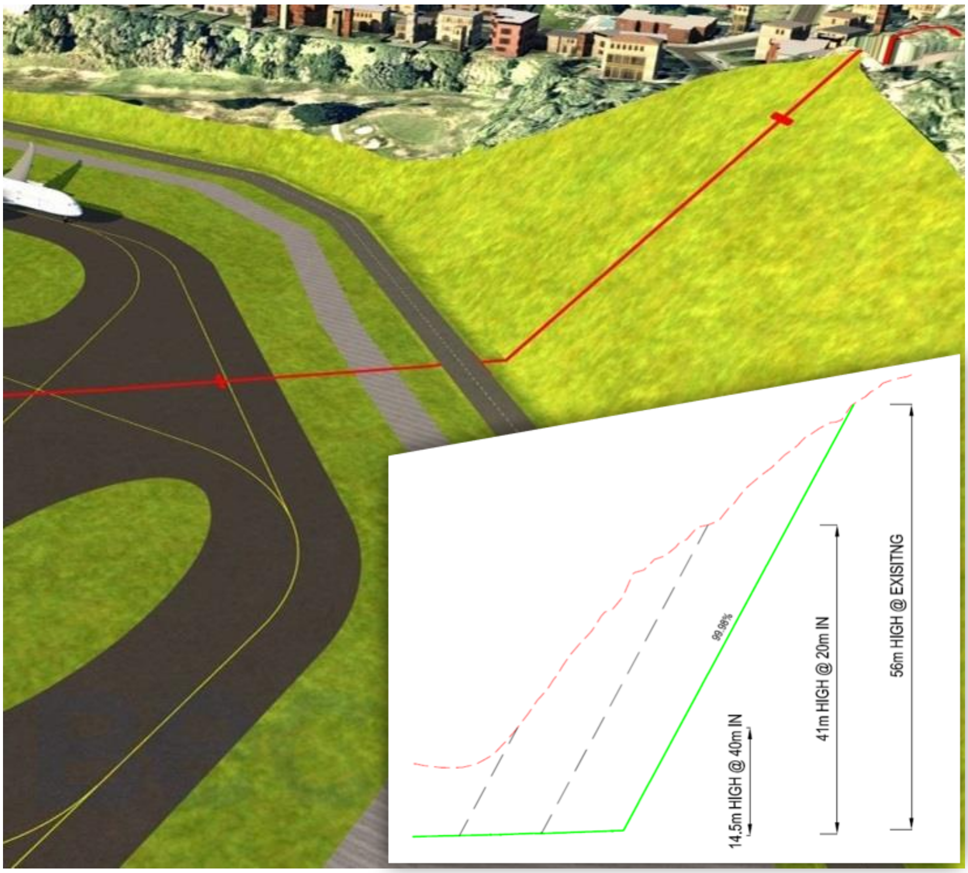

Figure 2: Concept of the proposed maximum cut slope (approximately 1:1)

14. In response to a further information request from the WCC, Beca was asked to conduct a desk-top study examining potential options for treating or retaining the higher cut-slopes.

Geology

15. The 1:250,000 published geological map of the Wellington region (Begg & Johnston, 2000) shows the area is underlain by Holocene (deposited in the last 10,000 years) shoreline deposits of marine gravel, sand, mud, and beach ridges. The hillslopes immediately behind the golf course are fine-grained metamorphosed sandstone (greywacke) interlayered with mudstone (argillite), known as Wellington Greywacke. Colluvium (slope debris) mantles the surface of the hillslope and colluvial wedges occur at the toe of the slopes. The location of beach deposits, colluvium and greywacke in relation to the proposed cut-slope is uncertain due to the scale of the geological map and the cover of colluvium.

Previous Ground Investigations, Soil Profile and Groundwater

16. Previous ground investigations in the area of the proposed cut-slope were collated from a review of the New Zealand Geotechnical Database (**NZGD**), and internal Beca reports. Investigations were previously completed for the waste-water treatment facility immediately south-west of the site, as outlined in Beca Stevens (1990)[2]. Approximate locations of the investigations are shown in **Figure 3**.

Figure 3: Mapped geologic units and previous geotechnical investigations.

17. The investigations undertaken by Beca Stevens suggest that the south end of the golf course is underlain by fill of varying thicknesses, and colluvium, underlain by *in-situ* greywacke. Investigations have not been performed across the remainder of the site, but it is expected that the remainder of the site will also be underlain by fill over Holocene sands, colluvium, and/or greywacke. The thickness of these deposits and depth to greywacke will be variable and cannot be determined without location-specific geotechnical investigation. I understand such investigations will be carried out in the future.

18. Depth to groundwater was recorded in piezometers installed as part of the Beca Stevens (1990) investigations. Monitoring indicates that groundwater was encountered at 5m to 7m below ground level and approximately follows the ground contour (equating to RL 4m and RL 14m in terms of the Wellington 1953 datum). The large difference is due to one piezometer being within the and colluvium the other within greywacke.

[2] Beca Steven (1990): Geotechnical Investigation Proposed Sites A and B Wellington Sewage Treatment Plant.

GEOTECHNICAL AND NATURAL HAZARDS

Fault Rupture

19. The Institute of Geological and Nuclear Sciences' (**GNS**) Active Faults Database identifies the Evans Bay Fault as trending north-to-south through Evans Bay approximately 1 km west of the site. The fault is considered 'active' because there is evidence for late Quaternary displacement (Begg and Mazengarb, 1996). Barnes et al (2018) estimate the fault has experienced one sea-floor rupturing earthquake in the past 10,000 years and is capable of generating magnitude (Mw) > 7 earthquakes.

20. The active Wellington Fault is located approximately 8 km west of the site. It is anticipated that a rupture of the Evans Bay or Wellington Fault would result in very strong ground shaking at the site. The shaking intensities would need to be evaluated and considered in the design.

Liquefaction and Cyclic Softening

21. Liquefaction may occur in loose saturated sandy soils as earthquake-induced cyclic shearing causes pore-water pressures to increase and exceed confining pressures resulting in a loss of soil strength. Liquefied soils may be transported downslope towards riverbanks or coastlines resulting in large lateral displacements at the ground surface. Surface effects of liquefaction include differential settlements due to the densification of the affected sandy layers and loss of material to the surface.

22. Soft clayey soils may additionally cyclically soften during earthquake induced shaking resulting in a loss of soil strength. Cyclic softening typically results in a number of liquefaction-like consequences including differential settlements of the ground surface. The Greater Wellington Regional Council (**GWRC**) Liquefaction Potential Map (Dallow et al., 2018[3]) indicates that the Holocene beach deposits beneath part of the site have a moderate risk of liquefaction.

23. The surrounding hillslopes are not considered susceptible to liquefaction.

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[3] Dellow, G.D.; Perrin, N.D.; Ries, W.F. 2018 Liquefaction hazard in the Wellington region. Lower Hutt, N.Z.: GNS Science. GNS Science report 2014/16. 71 p.; doi:10.21420/G28S8J.

24. The risk of liquefaction effects to the cut slopes, and any proposed retaining structures needed to mitigate this risk, must be considered during design.

Tsunami

25. Tsunami have previously affected Wellington Harbour, including a 2.5 m high wave recorded at Lambton Quay following the 1855 Wairarapa earthquake (GeoEnvironmental Consultants, 2001[4]). The Wellington Region Emergency Management (WREMO) Tsunami Evacuation Map shows the site as within the 'Yellow Self-Evacuation Zone'. The zone is modelled as being inundated under local source tsunamis with an Annual Exceedance Probability of 0.17, corresponding to a 6000-year return period and a maximum travel time of 1 hour. Possible wave heights are thought to be in excess of 10m.

26. Potential impact of a tsunami will need to be considered in the design of the cut slopes.

Flooding

27. The Greater Wellington Regional Council flood hazard map indicates that the site and surrounding hillslopes are not in a designated flood hazard zone.

Slope Stability

28. The Greater Wellington Regional Council Earthquake Induced Slope Failure Hazard Map assigns the hillslope to the west of the golf course land a failure risk rating of 2 to 3 corresponding with low to moderate risk of failure. The risk is based on slope angles, local geology, and slope aspect. Changes to the slope profile that might result from the proposed cut will change the slope stability rating.

29. A site-specific assessment considering impacts of the proposed cut-profile on the overall stability of the slope will be required prior to selection of any slope stabilisation measures or retaining structures as part of detailed design.

GEOTECHNICAL CONSIDERATIONS

30. Expansion of Wellington International Airport to the east may necessitate relatively high cut slopes (likely some 30 to 50 metres high) in order to create sufficient ground that is level with the existing taxiway. Where cut is required,

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[4] GeoEnvironmental Consultants (2001): Wellington Regional Tsunami Hazard Scoping Project, prepared for Wellington Regional Council.

WIAL will need to maintain the stability of the cut slope and to avoid or mitigate potential impacts to residential properties upslope.

31. Geotechnical investigations will be carried out prior to undertaking detailed design of any cut slopes, stabilising measures and/or retaining walls. At this stage the materials likely to be encountered in the cuts are inferred from the currently available information and are therefore indicative only.

32. Current concept designs shown in the proposed Masterplan are of a cut being retained by an approximately 500m long (in 3 segments) and 30m high concrete retaining wall. This is a feasible engineering solution, but its final design and consideration of other slope remediation and retaining techniques will depend on a number of factors, including the materials exposed in the cut.

33. Factors that will need to be considered are the susceptibility of the exposed and underlying materials to liquefaction, the strength and variability of the exposed rock mass, and the extent and continuity of fractures in the rock mass.

34. Stability of the cut will also be governed by the angle of the cut and height of the slope created, which are likely to be controlled by the proposed realignment of Stewart Duff Drive and the geometric design of the proposed taxiway.

35. A range of possible retaining options that might be considered, depending on the nature of the ground, are outlined in paragraphs 36 to 41 below. A combination of these solutions may be considered if the soils vary along the length of the cut.

Benched Natural Cut Slope

36. The cut slope could be contoured so that the natural soils and rocks are exposed. Typically, benching (on the order of 3m to 5m wide) is required. The feasibility of this option depends on the nature of the materials encountered in the slope and the angle required to achieve stability of the slope. Slope stability assessments following the geotechnical investigations would be required to assess the feasibility of this option. This option may need to be combined with other engineering techniques, such as use of rock bolts or mesh (see paragraph 38).

Rock Stabilisation

37. If greywacke makes up much of the height of the cut slopes, rock stabilisation measures such as rock bolts, anchors, shotcrete and wire mesh with catch fences, may be feasible.

38. Options to stabilise the cut rock slopes can be developed following a geotechnical investigation and comprehensive rock face mapping exercise and may include:

    (a) Graduated slope cut face angles dependent on the strength of the greywacke (steeper in stronger less fractured rock and gentler in weaker more closely fractured rock or soil),

    (b) Rock bolting or anchors, combined with face protection such as shotcrete, or wire mesh.

Mechanically Stabilised Earth (MSE) Wall

39. Potential factors impacting the feasibility of this option include:

    (a) The available space between the wall face and designated boundary may mean the required overall slope angle cannot be achieved.

    (b) Depth to rock may limit excavation behind the wall for placement of geogrid reinforcement.

    (c) Susceptibility of the underlying soils to liquefaction may impact the overall stability of the structure, but this could potentially be mitigated by applying ground improvement techniques.

40. A ‘green’ option consisting of a sloped front face and an erosion control blanket, behind the geogrid, can be designed to facilitate the establishment of natural vegetation.

Concrete Retaining Wall

41. A concrete retaining wall, such as that shown in the concept drawings, may be considered where the materials encountered in the slope are considered unsuitable for the above options, or where geometric designs dictate a slope profile that is unable to be retained by other solutions. The retained height is

such that, alternative retaining walls systems such as timber pole and panel walls are unlikely to be feasible.

SUMMARY OF OPTIONS AND RECOMMENDATIONS

42. A ground investigation programme will be undertaken in the location of the proposed cut slopes and retaining wall to determine the nature of soils, depth to *in-situ* rock, and liquefaction susceptibility of the materials that might be encountered in the cut-slope. The results of the investigations will be required to allow identification of feasible options for slope cut and stabilisation measures.

43. Analysis of the stability of the slope above the stabilised slope and/or retaining structure would be carried out to assess risk, and if appropriate, design mitigation to avoid impacts to the residential properties above and limit risks to downslope areas. The assessment will inform design which may include a rockfall catch fence and/or rock anchors/soil nails to support the soil or rock above the proposed retaining wall.

44. I recommend the following to be undertaken prior to any works commencing on the site and then as the development progresses:

    (a) Intrusive geotechnical investigations, including drilling of boreholes, cone penetration testing (CPT) and geological mapping of the area.

    (b) Geotechnical assessment of liquefaction, slope stability and effects of geotechnical hazards.

    (c) Detailed design of cut slopes, stabilisation measures, retaining structures and rockfall fences.

    (d) Geotechnical and geological monitoring during construction, including but not limited to; rock cut slope defect mapping, inspection of retaining wall foundations, rock anchor pull out tests and rock netting tests.

EARTHWORKS AND CONSTRUCTION MANAGEMENT

45. I understand that it is proposed that the NOR will include a condition which relates to the management of earthworks and construction activities. This

condition will include an Earthworks and Construction Management Plan (**ECMP**). The Earthworks and Construction Management Plan will:

(a) Describe the methods proposed for the development of the Designated Area and the programme for earthworks and construction activities, including any staging;

(b) Provide details regarding the quantity of excavated material and the location in which it will be stockpiled, used elsewhere within the Airport, and/or transported from the site;

(c) Describe what actions will be taken to manage the actual or potential effects arising from earthworks and construction activities including, but not limited to:

(i) Specific erosion and sediment control and stability requirements proposed on the site, management and monitoring requirements;

(ii) Construction noise and vibration so that it complies where practicable with the requirements of New Zealand Standard 6803:1999. Where any construction activity or work cannot comply with the New Zealand Standard 6803:1999 an understanding of the extent of the noncompliance is required to be detailed in the plan along with fit for purpose mitigation measures to properly manage the effects of any exceedances. Methods employed to assist with this during construction activities shall include, but not be limited to the identification of mitigation and management measures necessary to assist in reducing the effect of construction noise and vibration on sensitive receptors (such as the selection of construction equipment or methods, hours of operation, screening of the affected area, temporary relocation of persons directly affected);

(d) Traffic related movements and parking.

(e) Provide a list of key personnel and points of contact during earthworks and construction activities;

(i) Describe how adjoining landowners will be kept informed during earthworks and construction activities;

(ii) Describe staff training and induction requirements to implement the Earthworks and Construction Management Plan;

(iii) The establishment of a complaints procedure;

(f) As far as practicable all fill extracted from the site shall be stored and/or utilised within land or projects being undertaken by the Requiring Authority. If the material is to be stockpiled for a period of longer than 15 days, the material shall be suitably covered and/or rehabilitated so as to not cause a dust nuisance or generate sediment runoff.

(g) All construction related plant and equipment shall be stored within the Designated Area or other Airport land.

46. I consider this condition to be appropriate for managing earthworks and construction activities as the site is developed.

RESPONSE TO SUBMISSIONS

47. Submissions by Guardians of the Bays, Tim Jones and the WCC Environmental Reference Group have expressed concern that WIAL has not provided any information on volumes of earthworks and the effects related to construction (such as numbers of truck movements). In response to this, I note that the draft Master-Grading plan takes into account the whole of the proposed ESA area, as well as part of the Main Site Area.

48. Moreover, the quantity of earthworks required for the whole apron area will not occur all in one go, as WIAL will be progressing in stages (as referred above). Furthermore, the total volume of earthworks can be considered the maximum; that is, as design is refined this volume will reduce, possibly significantly. I believe the required Earthworks and Construction Management Plan, which is required to detail the quantity of material excavated and transported will appropriately manage earthworks and construction related effects.

CONCLUSION

49. In my opinion, earthworks (which will be undertaken in stages) can be managed and engineering solutions to develop the site are feasible. These engineering solutions are likely to consist of a combination of benched natural cut slopes, rock stabilisation (rock bolting or anchors), mechanically stabilised earth (MSE) walls, and concrete retaining walls.

50. Further in my opinion the ESA site is not at risk of significant geotechnical or natural hazards and any risks can be appropriately management through the detailed design of the development including full geotechnical investigations as outlined in paragraph 44 above.

Philip Robins

5 May 2021