BEFORE COMMISSIONERS APPOINTED BY THE CANTERBURY REGIONAL COUNCIL

UNDER the Resource Management Act 1991

IN THE MATTER applications for resource consents by Lyttelton Port Company for capital and maintenance dredging

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SUPPLEMENTARY EVIDENCE OF JOHN WARWICK OLDMAN FOR NGĀI TAHU

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Introduction and summary

1. My full name is John Warwick Oldman. My experience and qualifications are set out in my primary evidence dated 4 April 2017.

2. This supplementary statement of evidence comments on the rebuttal evidence of Dr Beamsley dated 28 April 2017.

3. Firstly, I would like to thank the panel for giving me the opportunity to digest and consider the summary evidence of Dr Beamsley. It has been a very useful exercise for me to step back from the details of the complexities of modelling fine-grained sediments and consider what it is we are trying to do here. In my opinion, the key question is, does the inclusion or exclusion of various model parameters or the way a model is applied once it is calibrated alter the outcome of an assessment of effects?

4. I have reread the application documents, evidence and summary evidence of Dr Beamsley. Here is my interpretation of the conclusions in those documents:

   (a) **Application Document.** A series of model runs using a static dredger without winds and waves and with no resuspension indicate that the dredge plume will not move far from the dredger location. This assessment is based on approximately 75% of spill material being placed near the seabed and 25% placed in the water column. Based on this information LPC have initiated a monitoring programme and are designing an EMMP with an end result of being able to effectively manage effects that may occur under conditions that haven't been modelled.

   (b) **Summary-in-chief and Appendices (29th of March).** Further model runs which include residual offshore currents and resuspension show that the dredge plume will not move far from the dredger location. Conclusions from the application document do not significantly change.

   (c) **Summary evidence (28th of April).** Based on additional model runs and following on from discussions at caucusing on the 27th of April, Dr Beamsley concludes that "adaptive management could be used to mitigate potential re-suspension".

5. This summary evidence is significant. It changes the focus from the modelling in and of itself, to how well this modelling might be applied to an EMMP. The process and complexities as to how LPC have got to the point of saying “our models show some effect that needs to be managed” is important and still needs to be unravelled. I expect to address this at caucusing.

6. In my expert opinion, there is a possibility of an impact within Whakaraupō from the proposed dredger operation. This expert opinion is based on my involvement in previous dredging studies, my experience with modelling fine-grained sediments in harbours and a body of international evidence that demonstrates that it is important to plan and manage the potential impacts of dredging, as set out in my evidence in chief. Once deposition of fine-grained sediment has occurred, it cannot be wound back. Under the influence of tides, winds and waves, sediment in the water column and sediment that is allowed to erode from the sea-bed can be transported significant distances from its source. That is my expert opinion.

7. In this document, I have provided rebuttal to D. Beamsley’s summary evidence under key thematic headings. At the rear of this document I cross-reference these discussions with the specific paragraphs in Dr Beamsley’s rebuttal. I expect to make further progress at caucusing.

8. None of Dr Beamsley’s comments address the fundamental issue which remains a point of difference between us. That issue is that to provide information which is useful for both the assessment of effects and the management of the dredging operation, the model (or models) used to assess the possible effect of the proposed dredging operation should include all processes that may influence sediment plumes, irrespective of where in the water column they are initially placed. In my opinion, it is critical, and consistent with best practice in New Zealand and internationally, that the model includes these parameters in combination. While he does not state it explicitly, I perceive from my discussions with Dr Beamsley and from his evidence, that he does not agree. I will discuss this at caucusing.

9. Fundamentally, I think we may have a different approach to modelling. Dr Beamsley has started from a model which included tides, no winds and no resuspension. Since my involvement in this work,

resuspension and residual currents have been added to the LPC model. Over this time, the conclusions from the LPC model have shifted towards the conclusions that, at times sediments may be deposited outside the dredge corridor. I do not know if this is just a difference in modelling approach or an artefact of the legacy nature of this work (as discussed by Dr Pritchard).

Waves

10. In paragraphs 129 to 137 of his rebuttal evidence, Dr Beamsley discusses the inclusion of waves in the model.

11. Here is my interpretation of the discussion that the Panel had with Dr Stephenson. In his summary evidence (paragraph 27) Dr Beamsley states "*Dr Stephenson suggests that wind waves generated soon after dredging operations will further disperse sediment plumes*". I agree with this "suggestion". In the presence of waves, sediment plumes remain in the water column for longer periods of time (because put simply, there is more energy in the water column to keep them in suspension), as such they are spread more widely.

12. Dr Beamsley's evidence shows that this is the case. At the offshore spoil ground, the presence of waves in his model result in the sediments moving off the sea-bed (i.e. towards the surface) and they are then transported away from the spoil ground (by ambient currents). If you model any number of combinations of tides and winds without waves the spoil ground material will not move from the spoil ground. Based on any number of model runs without waves it could be concluded that spoil ground material will never move.

13. Finally, in his summary evidence (paragraph 28) Dr Beamsley says "*Compared with the effect of tidal and seiche velocities, locally induced wind generated waves are expected to have a less than minor effect on the re-suspension of sediment*". I agree with this statement in deeper water where the dredger will operate. As sediment moves away from the dredger and into shallower water (which it might do if winds were included) the less than minor effect will become moderate and then major. So, only by modelling winds can you show an effect of wind-waves on a sediment plume. If you don't model winds the plume won't move into shallower water and you don't need to consider wind-

generated waves. That is why it is important to model tides and winds in combination.

Resuspension

14. In paragraphs 90 to 128 of his rebuttal evidence, Dr Beamsley discusses resuspension.

15. I believe, in the absence of field data, a realistic range of erosion thresholds that should be considered are 0.05 to 0.2 N/m^2. Modelling a small erosion threshold will result in more sediment in the water column, more often. Modelling a larger threshold will significantly reduce the amount of erosion and where it happens.

16. I will clarify with Dr Beasmley during caucusing, if we are in agreement that, in the absence of field data, a 0.1 N/m^2 erosion threshold (as he has used to calibrate his models) is appropriate to use to carry out the assessment of effects in Whakaraupō.

17. I will try and clarify why waves have not been considered along the outer dredge corridor and why the argument seems to be that waves will never suspend material here.

Winds

18. Dr Beamsley shows in Appendix A of his evidence-in-chief that the magnitude of wind driven residuals near the sea-bed are small. If we had discussed this at caucusing I would have agreed with him.

19. If you consider, in isolation, the possible influence of wind-driven currents on sediments near-the bed it will be minimal: it will not be zero. Running a model with and without winds and sediments near-the sea-bed will result in numerical predictions that are different. As Dr Beamsley shows at the site offshore where small residual currents have been used.

20. What has not been considered here is that sediment must first get to the sea-bed by falling through the water column or it is resuspended away from the sea-bed. I don't think that could be argued against. For example, if the sediment is sourced from a Green Valve overflow from a large hopper dredge some spill material will be in the surface layer of the water column. I repeat below the figure I presented to the Panel last Friday. Here we have a Green Valve which is being operated very

efficiently, under calm wind and wave conditions from a large hopper dredging fine-sediments. The relevant point is that “some” of the sediment is in the water column. That means that some of the spill material will be influenced by winds and also that some will be moved away from the dredger (i.e. the analogy provided by Mr H. Couch is accurate: “smoke doesn’t blow up wind”). It is important to emphasise that “some” is not zero. That is why it is crucial to schematise the initial release from the dredge spill. Some sediment will be in the water column. The latest evidence from LPC indicates that the water-column term could be as low as 1%. If the 1% is used, 99% is near-the bed so understanding the movement of that material becomes even more important.

21. That is why winds must be included in a sediment transport model of fine-grain spill material. The cohesive nature of sediments doesn’t exclude them from the forces of the wind when they are in the water column. Dr Beamsley has stated that if the majority of sediment resides near the bed, winds can have very little influence (because wind driven currents are small near the bed). I agree with the specific point, but I do not agree that it logically follows that winds do not need to be considered in the model at all.

22. In paragraph 139 of his summary evidence Dr Beamsley states the following:

> "*if the dynamic plume collapses over a larger range, then the resultant concentration will be less (as the same fraction of sediment expected to be included into the passive plume is dispersed over a larger area). Conversely, if the dynamic plume collapses over a smaller range, initial concentrations will be higher but will rapidly decrease as they are mixed into the far field*".

23. I agree with the above.

24. However, the potential impact of modelling the different dynamic plume collapse scenarios (described above) is significant. Modelling a high concentration "point" source or a low concentration "diffuse" source will give different results away from the source. This matters because it is important to get the complex dynamics of the spill as it moves away from the dredge right. It needs to be schematised in the model and how that is done is important. That is why I was surprised to see the 25% had been reduced to 1% without any detail in the summary evidence about how or why and that was derived. I will clarify this at caucusing.

Demonstration Model Impacts

25. In paragraph 103-112 of Dr Beamsley discusses the impacts of the demonstration model.

26. I covered this at the hearing last week. To assist the panel, I emphasise two key points here:

    (a) The outputs from the demonstration model show that the inclusion of wind, waves and resuspension in combination with a moving dredger make a difference to models of Whakaraupō / Lyttelton Harbour.

    (b) In my expert opinion, the outputs from the demonstration model are not less than minor.

Depth Average Model and Winds

27. In paragraphs 58 and 65 of his summary evidence, Dr Beamsley discusses in detail my original concern about the absence/presence of winds in a model and the use of depth-averaged or three-dimensional models.

28. As he states “A 2D model solution with winds will provide potentially erroneous velocity field”. I agree. However, erroneous velocity fields are not only a bad thing in themselves they also effect the predicted transport of sediment plumes. I am not sure if Dr Beamsley is arguing it would be wrong to use a two-dimensional model with winds (i.e. just add wind to the existing 2D model of the harbour) or to model winds as part of a three-dimensional model (as was done for my demonstration model). The real question here is does a two-dimensional or three-dimensional model provide a “better” result. That can only be resolved with calibration. Then, the model that gives the best result can be quantified and applied to the project.

Model errors

29. In paragraph 45 of the summary evidence Dr Beamsley states that if a model over- or under-estimates currents near the bed, that model predictions “are not likely to be altered”. I disagree. Especially if the key purpose of running that model is to determine how far sediment may move from its source. Any error will have a cumulative effect over time. A model run with even a small error can, in time, lead to significantly different results.

Depositional Threshold

30. The evidence-in-chief of Dr Beamsley indicate that the use of depositional threshold produce “improbable results” or unrealistic behaviour. I disagree.

31. I don’t know if Dr Beasmley is talking in general here or if he has run models with a depositional threshold and has found “unrealistic” results. I will clarify this at caucusing.

Use of Model for planning and design of EMMP

32. In paragraph 151 – 154 of Dr Beamsley’s rebuttal, he discusses the incorporation of knowledge gained from this modelling exercise into the EMMP.

33. A crucial part of developing an EMMP is to develop a Daily Spill Budget. This will include, dredging location, spill volume and if there are any predicted impacts from spilling in different parts of the harbour. This concept was discussed with LPC at a meeting on the 31st of January.

34. The basic level of information required to develop a Dredge Spill Budget is to quantify the dredge spill volume. Based on dredging projects I have worked with, it is a fundamental part of any EMMP. I'm not sure if LPC have even considered this most basic level of spill management.

35. For example, the evidence of Mr Pronk (paragraph 69) indicates that a total of 45 hopper loads might occur each week. The mid-range spill duration is a 20-minute overflow. That would result in an overflow for 15 hours each week.

36. Using the overflow rate used by Dr Beamsley (1600 kg/s) and the assumed 1% in the surface layer, a total of 864 tonnes per week is placed in the water column. That is what Dr Beamsley refers to in paragraph 61 of his summary evidence as being "low". He argues that the effects of moving that amount of fine-grained sediment by the wind is "minor" so that logically winds do not need to be modelled.

37. This sort of information is the starting point for an EMMP, however I have not seen any reference to doing this. This is something I will clarify at caucusing.

38. It is important to get model parameters right and it is crucial if you are going to manage any <u>actual</u> impact.

39. Recently DHI was involved in the Wheatstone project in Western Australia. Impact was simply managed by 1) understanding the source (i.e. what was actually being spilt or is planned to be spilt over the coming days) and forecasting where it might go based on forecast winds, waves and tides. That approach allowed the dredge project to continue through a coral spawning period – the first time this had ever been achieved. This is a win-win situation; the dredging work was done efficiently in the minimum amount of time and with minimal environment impact.

Summary

40. The processes included in a model and how they are used in the model matter because they can change the predicted results. As shown by my demonstration model you move from no impact outside the dredge corridor to identifying areas of potential impact. Given the amount of work that has been done by LPC since I submitted my

evidence in chief, I do not consider that it would be a very onerous, expensive or time consuming task to apply existing tools, to assess effects and develop an EMMP. We have gone from a model which didn't include winds and resuspension to one that now predicts an impact if dredging were to occur only around Cashin Quay. The missing components are winds and waves and considering the effects of a moving dredger.

41. The reference to the inputs being 'in combination' is critical. This is not addressed at all in Dr Beamsley's rebuttal evidence. Rather, his evidence takes each of these important elements in isolation and makes comments about them in turn. In my opinion, this approach fundamentally misunderstands the concerns that I, Dr Stephenson and Dr Pritchard have raised during the hearing process.

PARAGRAPH BY PARAGRAPH RESPONSES TO DR BEASMLEY

42. I consider that my summary rebuttal above, addresses all points raised in Dr Beamsley's rebuttal evidence dated 28 April 2017. However, for the panels benefit, in this section I have cross-referenced my response to each section of Dr Beamsley's rebuttal evidence.

Paragraph 41 - 45. Regarding Offshore Current Modelling.

43. This section in Dr Beamsley's rebuttal concerns the quantification of near bed currents and the likely effects of an over- or under-estimation of these currents in the model. I address this in paragraph 29 above.

Paragraph 46 – 51. Regarding Erosion threshold and rate

44. This section in Dr Beamsley addresses the use of a depositional and erosion threshold. I address this in paragraphs 14-17 above.

Paragraph 52 – 55. Regarding depositional threshold

45. In this section of Dr Beamsley rebuttal evidence, he discusses the use of a depositional threshold. I am not saying one must be used as suggested by Dr Beasmley in paragraph 53. This is just one parameter than can significantly alter model results. Following on from our meeting of the 27th of April, I now understand why the erosion rate is the crucial factor to calibrate a model. Events are chosen when erosion is happening so the rate is important.

Paragraph 56 – 57. Inshore Harbour model (absence of wind in the model)

46. I address this in paragraphs 18 - 24.

Paragraph 58 – 65. Inshore Harbour model (Used of depth averaged approach)

47. I address this in paragraphs 27-28.

Paragraph 66 – 78. Inshore Harbour model (Resuspension)

48. I address this in paragraphs 15.

Paragraph 90 – 128. [Outcome of meeting on 27th April, 2017] (Resuspension)

49. The essential point is that Dr Beamsley accepts that resuspension is important at the offshore spoil grounds. In his paragraph 130 he provides new information that it is also important "*in the vicinity of Cashin Quay under peak flows*". However, this important last-minute inclusion has not been incorporated into the modelling for this project. In my opinion, more work is required to establish where and when resuspension is important, before the decision not to include it can be made.

Paragraph 128 - 137 [Outcome of meeting on 27th April, 2017] (Waves)

50. I address this in paragraphs 16-17.

Paragraph 138 – 145. Unresolved issues – spill dynamics near the dredger

51. I address this in paragraphs 22-24.

Paragraph 146 – 150. Unresolved issues – cumulative effects of spill

52. Dr Beamsley suggests that there will be no cumulative effects because sediment will deposit quickly and resuspension is limited. That would only be the case if all spill material from the current dredge location will be deposited by the time a dredger comes back to dredge again and no erosion is occurring. He also assumes there can be no cumulative effect from the ongoing deposition of spill material. This would only be the case if the spill material is never resuspended or it is all dredged again. I disagree that there can be no cumulative effect.

Paragraph 151 – 154 Environmental monitoring and management plan design and implementation.

53. I address how models can be used to inform the development of an EMMP in paragraph 32-39.

Date: 8 May 2107

John Oldman