Before the Independent Hearing Panel
Appointed by the Southland Regional Council

Under	the Resource Management Act 1991 (**RMA**)
In the matter of	an application by **South Port NZ Limited** to dredge parts of the Bluff Harbour

---

Supplementary statement of evidence of Bryony Miller

27 July 2022

Applicant's solicitor:
Michael Garbett
Anderson Lloyd
Level 10, Otago House, 477 Moray Place, Dunedin 9016
Private Bag 1959, Dunedin 9054
DX Box YX10107 Dunedin
p + 64 3 477 3973
michael.garbett@al.nz

anderson lloyd.

Qualifications and experience

1 My name is Bryony Miller.

2 I have prepared a statement of evidence dated 29 March 2022 and supplementary evidence dated 7 July 2022. My qualifications and experience are set out in my initial statement dated 29 March 2022. I confirm that this supplementary evidence is also prepared in accordance with the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note 2014.

3 This statement addresses the questions raised by the Commissioners in Minute 1 that relate to my expertise. These are contained in questions 3 A - G. I have set out the questions and my responses below in this evidence.

Minute 1; Question 3

4 **Question 3A.** Paragraph 26 of Ms Miller's Supplementary Statement of Evidence states daily average (24-hour) Tier 1 and 2 turbidity triggers and Tier 3 compliance limit were calculated from the reference turbidity data at each of the three monitored sites as the 80th, 95th, and 99th percentiles, respectively – the results for each of the three sites being presented in Table 1 of her Statement. Paragraph 27 states these daily average tiers are proposed to be utilised during the dredging of the berth pockets where finer sediments occur and paragraph 31 states a turbidity tiered trigger consent condition was developed, and this is provided on page 18 of the Attachment 1 Technical Memorandum. However, the proposed condition (which also appears in Mr Beale's set of proposed conditions as Condition 18) presents a single set of turbidity values which would apply to the "Tiwai wharf seagrass beds" as well as the "Rabbit Island seagrass beds". The turbidity values used in the condition are based on the data obtained from the Rabbit Island seagrass monitoring site, which had markedly higher turbidity statistics than the Tiwai wharf seagrass monitoring site.

Please advise why the turbidity triggers and compliance limit for the Tiwai wharf seagrass beds are the same as those for the Rabbit Island seagrass beds site in the table that is included in the conditions, when their statistics/tiers presented in Table 1 of Ms Miller's evidence show them as very being different, especially the Tier 2 and 3 numbers. We also note that the Tiwai wharf seagrass beds are located downstream of the proposed dredging (on the basis that dredging would be restricted to ebb tides) so would have expected the turbidity triggers and compliance limits calculated for that site to have been used instead of the more lenient Rabbit Island seagrass site data.This additional information has been sought by the

Independent Commissioners hearing the South Port resource consent application.

5 **Response to 3A**. The purpose of the baseline data collection carried out in May 2022 was to establish natural variance and upper range of turbidity which the seagrass beds within Bluff Harbour tolerate under natural conditions. Both the Tiwai wharf and Rabbit Island seagrass beds consist of the same species of seagrass (*Zostera muelleri*) at similar depths, and it is extremely unlikely that seagrass in the two areas will exhibit different sensitivities to the range of turbidity values encountered naturally, over the short period of dredging activity. Accordingly, I am confident the turbidity levels encountered at the Rabbit Island site are well within the environmental tolerance levels of the seagrass beds at Tiwai wharf.

Further, in response to the commissioners comment in paragraph (para) 4 "*We also note that the Tiwai wharf seagrass beds are located <u>downstream</u> (*my underline*) of the proposed dredging (on the basis that dredging would be restricted to ebb tides)*". The location of the Tiwai wharf seagrass bed in relation to the dredging area is not downstream as is stated in para 10 e) of my supplementary evidence (dated 7 July 2022) "*Harbour tidal currents will convey disturbed sediment up and down the harbour more or less unidirectionally but have no direct pathway across the harbour to where the nearest (Tiwai wharf) seagrass beds are located*". Figures 1 and 2 are provided for greater clarity regarding the tidal pathway during the ebb tide. Please note; these figures are not new evidence and were initially provided in the Marine Assessment of Environmental Effects[1]; however, fine sediment dredging area, seagrass beds and turbidity meter locations have been added to figures for ease of understanding in this context.

[1] Miller, B. & Davis, G. (2021). South Port Capital Dredging Assessment of Marine Environmental Effects. Prepared for South Port NZ Ltd. e3Scientific Report No. 20041.1

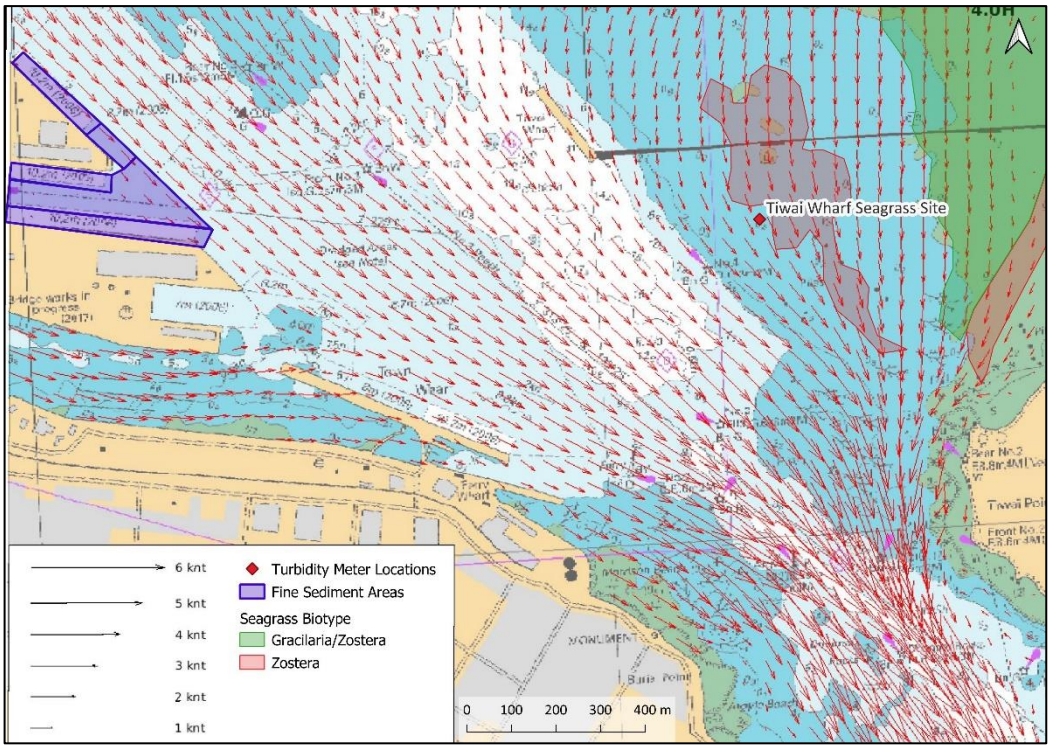

Figure 1: Spring ebb tide (4 hours after slack). Fine sediment dredging areas outlined in purple.

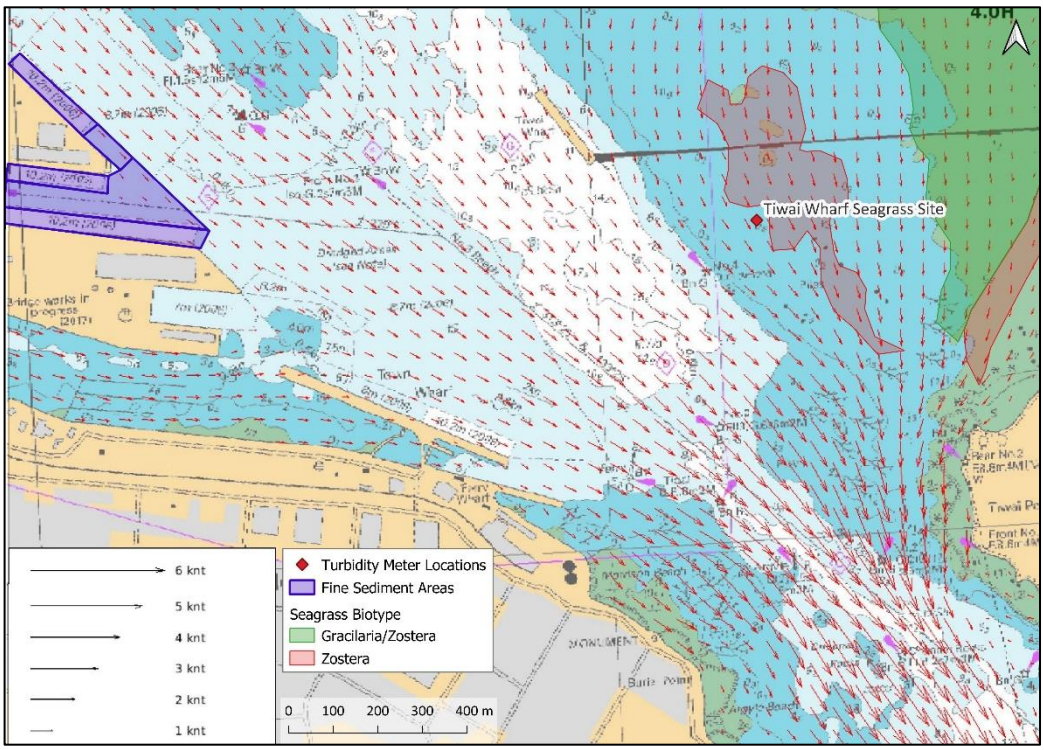

Figure 2: Neap ebb tide (4 hours after slack). Fine sediment dredging areas outlined in purple.

6 **Question 3B.** Paragraph 12 of Ms Miller's Supplementary Statement of Evidence makes reference to a paper by Chartrand *et al*., 2016 (as does the Technical Memorandum attached to her evidence).

Please confirm, or otherwise, that this is a new reference which was not included in any of the evidence provided at the hearing or in the application documents. Please also provide an assessment of whether the conclusions presented in that paper are directly transferable to the Bluff Harbour given the work was undertaken in tropical waters and perhaps on different seagrass species.

7 **Response to 3B.** Yes, this is a new reference. The Chartrand *et al.*, 2016[2] journal article refers to *Zostera muelleri* subspecies (ssp.) *capricorni.* The New Zealand subspecies *Zostera muelleri* subsp. *novazelandica,* found in Bluff Harbour, has highly comparable genetic and morphological characteristics to *Zostera muelleri* ssp. *capricorni* which is found in both temperate and tropical environments in northern New Zealand and along the east and south coast of Australia. Further, these two subspecies are often referred to collectively as *Zostera muelleri* which range from temperate to tropical waters along the south and east coasts of Australia and throughout New Zealand. The taxonomony of *Zostera* is summarized briefly in Turner & Schwarz (2006):

"*Les et al. (2002) recommended the taxonomic merger of Australian/New Zealand Zostera into a single species, Z. capricorni. Recent molecular genetic and morphological analysis has indicated that Z. capricorni and Z. muelleri should be considered synonymous (Waycott et al. 2004)*".

This was then more recently superceded in 2019 with a taxonomic change to *Zostera muelleri* with subspecies *capricorni* and *novazelandica*. The southern-most range of this species is currently Stewart Island and the range of *Z. muelleri* is primarily dictated by water temperature and light availability. Higher water temperatures promote longer growth periods, however, water temperatures above mid-twenties degrees Celcius can also cause ecological stress to the seagrass bed. A seagrass study of *Z. muelleri*

[2] Chartrand, K. M., Bryant, C. V., Carter, A. B., Ralph, P. J., & Rasheed, M. A. (2016). Light thresholds to prevent dredging impacts on the great barrier reef seagrass, Zostera muelleri ssp. capricorni. In Frontiers in Marine Science (Vol. 3, Issue JUL). https://doi.org/10.3389/fmars.2016.00106.

in temperate Kaipara Harbour[3] (Bulmer *et al.*, 2016 is also a new reference) refers to Chartrand *et al*., 2016, findings from which conclusions and inferences were drawn regarding *Zostera muelleri* bed senescent periods during the winter months. Bulmer *et al*., 2016 assess that this was based on the reduced daylight hours (light availability) and cooler water temperatures. Given the similar genetic and morphological characteristics between the *Z. muelleri* ssp. *capricorni* and *novazelandica* and the greater body of literature compiled regarding seagrass in Australia, inferences are commonly drawn between the two subspecies. The conclusion that there is no clear light dependant effect on *Z. muelleri* ssp. *capricorni* during seagrass senescent periods is therefore expected to be similar, if not identical, to predicted effects on *Z. muelleri* ssp. *novazelandica*, with variablility primarily restricted to the subspecies differing senescent periods. This senescent period, for *Z. muelleri* ssp. *novazelandica* is considered to be over the winter months when shorter days and cooler water temperatures naturally limit growth (Turner & Schwarz, 2006), and importantly, outside of the proposed dredging timeframe.

8 **Question 3C.** Figures 3 and 5 of the Technical Memorandum attached to Ms Miller's Supplementary Statement of Evidence includes plots of water depth over time. Why is depth not shown in Figure 4?

9 **Response to 3C.** As is noted in the caption for Figure 4 "Please note; loggers did not record tidal range/depth at this site." The logger at this location failed to record depth due to a technical failure with the instrument.

10 **Question 3D.** Paragraph 37 of Ms Miller's Supplementary Statement of Evidence states that utilising the 99th percentile as the compliance turbidity tier (Tier 3) has been accepted by consenting authorities for other capital dredging programmes (Port Lyttleton and Port Otago). Please advise whether these consenting authorities specified a minimum period of time over which data needed to be collected in calculating the 99th percentile statistic and, if so, advise how that period compares to the 15-day period used to calculate those proposed for the South Port proposal.

11 **Response to 3D**. Neither the Otago Regional Council nor Environment Canterbury specified a minimum period of time over which baseline turbidity data needed to be collected to calculate the 99th percentile for Port Otago Ltd (POL) or Lyttleton Port Company (LPC) capital dredging projects.

[3] Bulmer, R. H., Kelly, S,. & Jeffs, A.G. (2016) Light requirements of the seagrass, Zostera muelleri, determined by observations at the maximum depth limit in a temperate estuary, New Zealand, New Zealand Journal of Marine and Freshwater Research, 50:2, 183-194, DOI:10.1080/00288330.2015.1120759

Port Otago Ltd (POL) collected 3 months of turbidity data (logged every 15 minutes) at two locations in the Otago Harbour prior to the resource consent (ORC 2010.195) being granted[4] (Please note; Baddock, 2008, is a new reference). Turbidity tiers were calculated from the collected data which encountered a number of NTU spikes due to fouling of the instruments, which were then removed from the dataset. The proposed volume to be dredged by Port Otago was 5 million cubic metres and the majority of this capital dredging was carried out over 3 years between 2015 – 2018.

Lyttleton Port Company (LPC) had capital dredging consents granted prior to undertaking any targeted baseline turbidity data. Conditions of consent stipulated within the granted consents (CRC 172455 and CRC 172522) that 12 months of baseline turbidity data would be collected prior to capital dredging commencing. The proposed methodology to create the tiered turbidity trigger levels was provided within the Environmental Monitoring and Management Plan (EMMP) completed by LPC in 2016. This was to be updated and provided to Environment Canterbury at least 2 months prior to dredging commencing[5]. No numerical tier NTU values were calculated nor provided by LPC until after consent was granted. This consent was for the dredging of 18 million cubic metres of spoil over a number of years.

Shorter baseline turbidity data collection timeframes ultimately risks the proposed dredging activity having greater restrictions in place. If data is collected for longer periods, such as 12 months, it can capture known seasonal extremes in weather conditions such as high winds and weather fronts experienced in winter or spring months. The likelihood that any extreme natural weather events or shipping movements which could increase turbidity and risk halting the dredging activity would therefore be considered and accounted for within the imposed monitoring regime. I consider that the turbidity data collected in May 2022 accounts for the range of weather characteristics likely to be experienced during the proposed dredging season(s). I therefore consider that the data can be relied on as applicable and appropriate.

The POL data collection timeframe of 3 months of baseline turbidity data collection at 15 minute intervals equates to approximately 8,640 NTU data points (without outlier removal) at each of the two turbidity logger locations. With regards to the baseline turbidity data for South Port's comparatively

[4] Baddock, E. (2008). Turbidity monitoring in Otago Harbour data report. NIWA Client Report: CHC2008-171 December 2008 NIWA Project: POL09501. Prepared for Port Otago Ltd.

[5] Fox, D. R. (2018). Turbidity Triggers for Lyttleton Port Company's Channel Deepening Project (Environment Canterbury Certified). April.

small capital dredging project (approximately 20,000 cubic metres of fine sediments and 100,000 cubic metres of sand), over the 15-day data collection period in May 2022 the three turbidity loggers each collected over 9,500 NTU data points as a basis to derive the proposed turbidity tiers. To cover a proposed dredging timeframe of 7 days for the fine sediments and up to 6 weeks total of dredging, this data is considered appropriate and provides sufficient statistical rigour.

12 **Question 3E.** Paragraph 38 of Ms Miller's Supplementary Statement of Evidence states "*The data set percentiles used to define the tiered trigger levels have been calculated from 15-days of turbidity data. When contributing environmental characteristics (i.e., wind run and speed) from this 15-day period were qualitatively examined next to the larger March to September period for which historical data is available, similar environmental characteristics were found. From this it has been concluded that the 15-day data set is representative and likely slightly conservative*." Please explain what 'qualitative' assessment was undertaken to justify the conclusion stated and please provide the evidence to support this conclusion.

13 **Response to 3E.** Visual inspection of the wind run data plotted in Figure 7 of my supplementary evidence (dated 7 July 2022) illustrates that there were four large wind events in the period 1 March to 30 September 2021. One of these events had greater severity (wind speed and wind run) than the event recorded on 25 May 2022 (Figure 6B of my supplementary evidence dated 7 July 2022). Quantitative analysis of this graph (by interpolation) confirms the qualitative assessment presented, as follows:

(a) As shown in Table 1 below, four storm events in the 2021 data had wind runs in excess of 1,000 km, in comparison with the recorded 25 May 2022 wind run value of 1,144 km (coinciding with the maximum measured daily average turbidity value of 10.76NTU, as noted above).

(b) The wind run recorded on 25 May 2022 of 1,144 km equates to 88% of the 2021 maximum wind run value of 1,300 km. This supports the qualitative conclusion that the turbidity trigger levels proposed are conservative in relation to the most severe naturally-occurring turbidities to which these seagrass beds have recently been exposed, and remain within the natural environmental range.

Table 1: Qualitative assessment of 2021 wind data.

Approximate storm event date	Daily average wind run (km) by interpolation
5 April 2021	1300
17 May 2021	1010
16 August 2021	1070
8 September 2021	1040

14 **Question 3F**. Tables 3 to 5 of the Technical Memorandum attached to Ms Miller's Supplementary Statement of Evidence show the dates over which turbidity (and other) data was collected at the three sites. Please explain why there are no data presented in Table 3 for 16 and 30 June 2022 when there are data for these two dates presented in Tables 4 and 5.

15 **Response to 3F**. Thank you for bringing this to my attention. South Port have since provided additional data from deployment on 16 May 10:00 to 10:00 on 17 May 2022 which was accidentally overlooked. No turbidity data is available for the half day of 30 May 2022 (00:01 to 09:30 - when it was removed) due to logger technical issues. Please note; data was not collected in June 2022. The additional data from the 16/17 May 2022 has been analysed in accordance with methods outlined in paras 18 and 19 of my supplementary evidence (dated 7 July). This additional data did not alter the number of outliers removed stated in my para 19, however, it does alter the total data points from 8,863 to 9,522. The updated Table 3 and Figure 8 are provided below. The 80th, 95th and 99th percentiles were recalculated for Tiwai wharf site based on this additional data; and the Tier 1, 2 and 3 NTU values were found to remain the same as reported in Table 1 and Table 2 of my supplementary evidence (dated 7 July 2022).

Table 2: Updated Table 3 from Bryony Miller supplementary evidence (dated 7 July 2022) with 16 May 2022 included. Alterations in **bold,** previous values in **()**.

Site	Date	Average of Turbidity NTU	Std Dev of Turbidity NTU	Max of Turbidity NTU	Min of Turbidity NTU
Tiwai Wharf seagrass site	**16/05/2022**	**1.84**	**1.82**	**12.84**	**0.91**
	17/05/2022	**1.65** (1.53)	**0.49** (0.42)	**3.88** (3.1)	**0.88** (0.93)
	18/05/2022	1.69	0.33	3.45	1.02
	19/05/2022	3.00	2.28	14.55	1.2
	20/05/2022	2.93	1.15	10.2	1.59
	21/05/2022	4.73	1.98	11.74	2.25
	22/05/2022	4.18	0.86	7.59	2.54
	23/05/2022	5.75	2.30	13.94	2.64
	24/05/2022	6.13	1.29	10.04	3.85
	25/05/2022	7.07	1.71	11.92	4.23
	26/05/2022	5.54	1.79	12.36	2.81
	27/05/2022	4.92	1.59	10.65	2.46
	28/05/2022	3.53	0.96	7	1.94
	29/05/2022	2.83	0.54	4.55	1.83

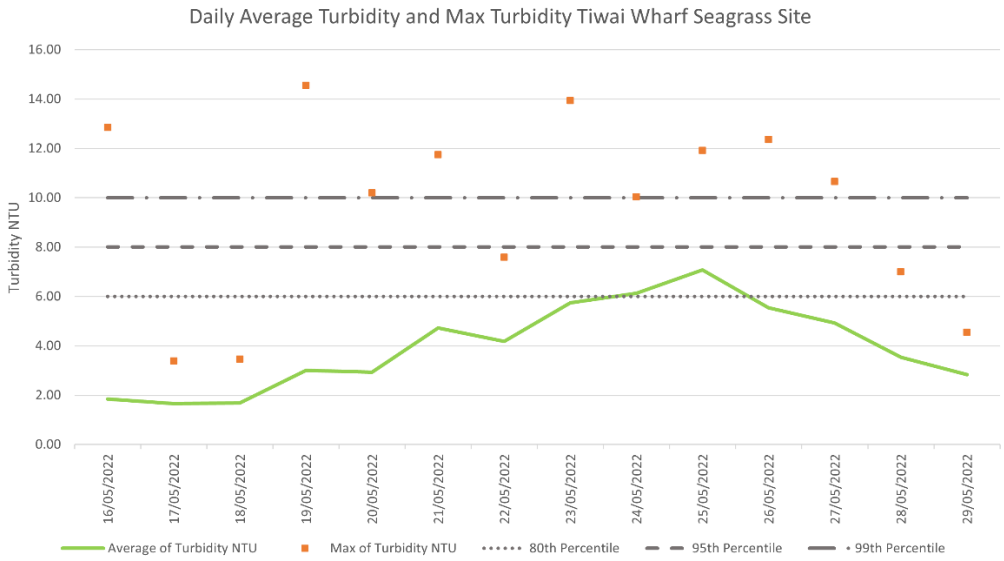

Figure 3: Updated Figure 8 A) from Bryony Miller supplementary evidence (dated 7 July 2022) with 16 May 2022 included.

16 **Question 3G.** Seagrass health monitoring is proposed to be undertaken at three seagrass bed sites as outlined in Attachment 8 to the proposed conditions. These three sites appear to be the same as the three sites where turbidity monitoring is proposed, however the map references of these sites appear to be slightly different to those referenced for the turbidity monitoring. Please explain this difference.

17 **Response to 3G.** The slight difference in location of the seagrass bed monitoring sites and associated turbidity monitoring is due to the turbidity meters being located at the closest edge of each seagrass bed to the dredging activity. The rationale for the logger location is to capture the greatest turbidity from the activity and to ensure the logger is in sufficient water depth to avoid exposure at low spring tides during rough conditions. At the turbidity meter locations the seagrass is patchy and irregular with areas of sand patches present. These outer margins to the seagrass beds are not optimal or the most representative habitat locations for seagrass bed health monitoring. The seagrass health monitoring is located in the seagrass bed habitat closest to the dredging activity (and loggers) where a consistent visible sward of seagrass cover is present.

Bryony Miller

27 July 2022