UNDER THE	Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012 (the Act)
IN THE MATTER OF	A Decision-making Committee appointed to consider a marine consent application by Coastal Resources Limited to undertake dumping of dredged marine sediments at a location offshore from Great Barrier Island.

STATEMENT OF EVIDENCE OF PETER CLIFFORD LONGDILL FOR THE DIRECTOR-GENERAL OF CONSERVATION

31 October 2018

Counsel for Director-General of Conservation

Bronwyn Arthur

Email barthur@doc.govt.nz

Telephone 027 245 6486

Department of Conservation

Conservation House – *Whare Kaupapa Atawhai*

PO Box 10 420, Wellington 6143

Telephone (04) 471 0726

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EXECUTIVE SUMMARY

A. I have been engaged by the Department of Conservation to provide expert advice and evidence in relation to hydrodynamics, oceanography sediment plume generation and dispersal, sediment transport, dredging and disposal operations, and associated environmental management matters in relation to the application by Coastal Resources Ltd (CRL) to dump dredged marine sediments at a location on the Continental Shelf (the Disposal Area) offshore from Great Barrier Island (the Application).

B. The prior use of the disposal site (an initial trial during 2011 and subsequent disposal operations from 2013 to 2018) along with the associated environmental monitoring undertaken during those periods has provided a substantial set of data which, for some aspects, reduce the need to wholly rely on numerical modelling predictions with respect to disposed sediment fate. In the specific case of suspended sediments within the water column (the sediment plume), there is only very limited prior monitoring which suffered from technical flaws.

C. The Application advises that the method of sediment removal from the source, prior to disposal, is generally by backhoe digger[1] (i.e. mechanical). Other methods of dredging (e.g. hydraulic), which have not been proposed, can degrade the source sediment grains (by abrasion and agitation during hydraulic transport) which then typically leads to greater sediment dispersion and environmental effect at disposal locations. A clarification to the Application's draft consent condition 8 is proposed to ensure that the condition is specific and prescriptive in the method of dredging to be used.

D. The Application proposed extensive monitoring of the seabed within the Disposal Area. The proposed conditions, however, do not indicate that the monitoring stations shall be aligned to the monitoring stations which have already been monitored from 2013 to 2018. It is advantageous to ensure a longer period of monitoring over time at the same stations. Accordingly, I suggest a clarification to the permit conditions to ensure alignment of the seabed monitoring stations with the previously monitored sites. Partial clarification on this aspect was made by the Applicant via evidence, however, that did not address all necessary monitoring sites, including control sites.

E. The Application did not consider adequately the cumulative effect of 'high frequency' barge disposals upon water column suspended sediment concentrations (turbidity). Of each barge load disposed between 1-5% of the load becomes suspended within the water column and subjected to passive dispersion process during which time most particles will slowly fall to the seabed. The Application advises that the suspended sediment plume is expected to be contained 'well within' the disposal area and draft consent conditions included a requirement for the consent holder to 'notify' the EPA if the sediment plume drifts beyond the disposal area, no specific quantitative monitoring for the water column nor sediment plume has been proposed within the application. Surface based visual observation is not an effective method to monitor a sub-surface plume. Although the barge disposal frequency was proposed to be restricted to 2 disposal events per 24 hours (via evidence on behalf of the Applicant), there has been no effective nor appropriate monitoring of water column suspended sediments as a result of the operation to date.

[1] Page 11 of the Application (AEE)

Accordingly, I suggest additional consent conditions to ensure that water column monitoring of the sediment plume is performed (at discrete times during the consent), and I suggest that the conditions include a requirement that the consent holder manage the operation to ensure that the operation does not substantially increase water column suspended sediment concentrations outside of the Disposal Area. This is more appropriate than a 'notification' only requirement which was suggested in the Application.

INTRODUCTION

Qualifications and Experience

1 My full name is Peter Clifford Longdill. I am the Environmental and Sustainability Manager for the Hamad Port Project within the State of Qatar. That project is a greenfield mega-project involving major capital dredging works (~60 million m^3). My employer is the Ministry of Transport and Communications. Previously, I held the position of Senior Project Manager and Senior Environmental Scientist for the Denmark based engineering consultancy COWI A/S, a position I held for over six years. I have also worked as an environmental and marine consultant for ASR Ltd and the University of Waikato in New Zealand. I have over 18 years' professional experience in the field of physical oceanography.

2 I have a Bachelor of Science in Marine and Environmental Geoscience from the University of Auckland, a Master of Science in Oceanography from the University of Waikato, and a Doctorate of Philosophy in Oceanography, also from the University of Waikato[2].

3 I am a member of the New Zealand Coastal Society (the NZCS) and the Coastal Education and Research Foundation (the CERF).

4 My areas of expertise include marine physical processes along with their interaction with ecological processes and water quality. This includes field data collection programs and environmental monitoring programs along with the development and application of numerical modelling tools to quantify these processes. I have applied these skills to coastal and marine projects including aquaculture, port, and dredging projects, both within New Zealand and overseas.

5 My work and research areas focus on identifying and quantifying environmental impacts arising from coastal and marine development along with the subsequent identification and implementation of appropriate mitigation and compensation measures. A key feature within my work is the application of both collected and remotely-sensed data, together with appropriate modelling tools to aid understanding and quantification of physical and ecological processes in coastal marine waters. For the past nine years, a significant period of my time has been spent on mega-dredging/reclamation projects (i.e., those involving in excess of 20 million m^3 of marine dredging and/or reclamation, and in one case ~60 million m^3) associated with coastal-residential and port developments. These projects involve (among others) backhoe, cutter suction and trailer suction dredger technologies along with reclamation, slurry disposal, fines removal and associated environmental concerns. I have been involved in these projects from an environmental control and management perspective throughout the planning, design, and construction/operation phases. I have led the development and permitting of these projects, led the design of environmental management systems for them, and managed the subsequent environmental monitoring programs. As a result, I am well versed with the prevailing environmental issues,

[2] Dr Longdill, completed his MSc and PhD theses at the University of Waikato from 2002-2006. Several technical reports related to the Disposal Area were prepared at the same university by students and professors, whom Dr Longdill interacted with. Dr Longdill assisted with data analysis and advice, in a senior student capacity, Dr. Bryna Flaim who completed her MSc and PhD on the Disposal Area. Dr Longdill is acknowledged accordingly within Dr Flaim's PhD. Dr Longdill does not consider that this conflicts nor influences his expert advice.

their best practice management, and the practicalities of field implementation of mitigation measures.

6 I have previously provided advice to the Department of Conservation in relation to other marine applications under the Resource Management Act 1991 and the Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012, including: New Zealand King Salmon Board of Inquiry, Trans-Tasman Resources and Chatham Rock Phosphate.

7 I have authored six published peer-reviewed scientific papers in my field of expertise in addition to numerous conference proceedings, consulting reports, and magazine articles.

Code of Conduct

8 Although this is not a hearing before the Environment Court, I have read the Environment Court's Code of Conduct for Expert Witnesses in the Environment Court Consolidated Practice Note (2014), and I agree to comply with it. My qualifications and experience as an expert are set out above. I confirm that the issues addressed in this brief of evidence are within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

Material Considered:

9 In preparing this evidence I have read and given consideration to:

a. the Marine Consent Application (comprising the Environmental Impact Assessment (the EIA) and the Appendices 1 - 7, dated May 2018) (hereafter referred to as the Application);

b. Flaim, B.K. (2012). Sediment Dispersion at the New Auckland Marine Disposal Ground, Northeast New Zealand. PhD thesis, University of Waikato.

c. Flaim, B.K. and Healy, T.R. (2008). Proposal for Dredged Sediment Disposal on the Continental Shelf in the EEZ: Environmental Impact Assessment, August 2008, University of Waikato.

d. Flaim, B.K., and de Lange, W. (2011). Post-Disposal Monitoring of the Auckland Marine Disposal Ground for Coastal Resources Ltd, Permit no. 555, February 2011, University of Waikato.

e. NIWA (2011). Review of Post-Disposal Monitoring of the Auckland Marine Disposal Ground, July 2011.

f. Bioresearches (2017). Post 150,000 m3 Disposal Characterisation of Seabed Changes, November 2015. A report prepared by Bioresearches for Coastal Resources Limited and dated 23 March 2017. Released under the official information act as the report was not included with the Application.

g. Hay (2018). Statement of Expert Evidence of David Neilson Hay for Coastal Resources Limited, 25 October 2018.

h. West (2018). Statement of Expert Evidence of Simon West on Marine Ecology on Behalf of Coastal Resources Limited, 25 October 2018.

i. Andrews (2018). Statement of Expert Evidence of Connon James Andrews for Coastal Resources Limited, 25 October 2018.[3]

SCOPE OF EVIDENCE

10 Within this evidence I consider:

a. the method of sediment removal from its source location and its potential to affect the sediments and thereby the sediment plume behaviour during disposal;

b. the alignment of the proposed sediment monitoring stations at the disposal site relative to stations used for monitoring for disposal operations to date;

c. the cumulative effects of the frequency of barge disposal on turbidity within the water column;

d. the draft consent conditions proposed initially within the Application, and then substantially modified and revised within the Statement of Evidence of David Neilson Hay.

[3] This evidence was only available for a limited period of time prior to submitted evidence being due for submission. A limited review only could be performed as the evidence contained a large quantity of technical material which was not included in the application,

METHOD OF SEDIMENT REMOVAL AT SOURCE (DREDGING METHOD)

11 The method of dredging has potential to directly influence (change) the sediment grain size parameters prior to disposal operations.

12 Mechanical dredging methods include material grabbed by bucket, clamshell bucket, backhoe diggers or similar. In these methods the bulk source material is removed and transported through the water column by the mechanical bucket. Hydraulic dredging methods include cutter-suction and trailing-suction dredging. In hydraulic dredging material is removed either by agitation or suction and transported through pipelines as a slurry.

13 Hydraulic dredging methods, which utilise pipeline-based transport and/or centrifugal pumps, alter the 'in-situ' sediment particle size due to particle attrition during transport. Sediment particle attrition during hydraulic transport occurs as sediment particles impact with each other, with the inner face of the pipeline, and within the pumps generating the flow[4]. Sediment attrition during pipeline slurry transport acts to break up sediment particles, smooth their edges, and cause a general fining of the sediment particle size distribution (i.e. increased proportions of fine sediments relative to the pre-dredged sediments). Mechanical dredging methods do not experience the same sediment attrition.

14 Increased proportions of fine sediments during the disposal operation (e.g. as a result of attrition) would be expected to lead to increased water column turbidity, as finer sediments would settle to the seabed at slower settling velocities compared to larger particles of the same density.

15 The sampling program proposed within the Application to characterise the sediments to be dumped does not consider, nor make allowance for, changes to sediment particle sizes caused by hydraulic transport[5] and its consequential effect on water column turbidity at the disposal site.

16 For all prior disposal operations at the NDA (and the associated monitoring), it is understood that the source sediments have been via mechanical means[6].

17 The Application confirms that the method of dredging would be 'generally' via digger[7] (i.e. backhoe), and this is further supported by the implied intention of proposed consent condition[8] 8 of the Application. However, the initial wording of the proposed consent condition does not ensure that material must be removed by mechanical means, it only required that the material had the potential to be removed by mechanical means. Accordingly, I propose to replace "*material which cannot be*" with "*material which is not*" in the proposed Consent Condition 8, i.e.:

> *The Consent Holder shall not source material from a Source Site, or dispose into the Disposal Area:*

[4] e.g. Barber et. al. (2012). Attrition of material during cutter suction dredging and pipeline transport: a summary. Barber, D., O'Dowd, B., Lee, M. 2012. Proceedings of CEDA Dredging Days 2012, Abu Dhabi, UAE.
[5] e.g. The in-situ sediment sampling program for source sediments as required by proposed consent Condition 1(a-c).
[6] e.g. Consent Condition 12(a) of EEZ Deemed Consent 900012
[7] Page 11 of the Application
[8] Page 24 of the Application

a. Any material which ~~cannot be~~ is not moved by mechanical means, and

b. *Any material "pumped" or mixed with water to produce a slurry.*

18 In the Statement of Evidence of Hay (2018), the proposed Consent Conditions have been amended, the (now) proposed Consent Condition no. 10 achieves the same intent as that described in the above paragraph. To be more explicit, the proposed Consent Condition no. 10 in the Statement of Evidence of Hay (2018) could refer to "*mechanical excavation*".

SEABED MONITORING STATION ALIGNMENT

19 Proposed consent condition 2(b) of the Application[9] sets out the anticipated seabed sampling locations and identifies that the "*Axes will be aligned in onshore (W) offshore (E) and alongshore (N, S) directions. Beyond 500 m from the Disposal Site Centre an additional axes will be added midway between axes (NE, SE, SW and NW directions).*"

20 The initial monitoring of trial dumps reported by Flaim and de Lange (2011) monitored sites aligned on axes aligned directly N-S, E-W. Then, from 2013 to 2018[10], it appears that the seabed monitoring sites were aligned on axes rotated by -22.5°, presumably to approximately align with local bathymetric contours.

21 There is no technical justification put forward in the application as to why the seabed monitoring sites, which were used from 2013 to 2018, should be moved/rotated. The accrued monitoring data at those sites from 2013 to 2018, provide an initial data set, on which further effects could be measured. Moving the monitoring sites upon issuance of a varied (or new) consent, would result in the loss of the ability to make direct inferences to the initial time-series of monitoring data. This would be a loss to the quality of monitoring data.

22 Accordingly, I recommend that the proposed condition 2(b) be amended as follows:

a. "….. Monitoring site axes will be rotated by -22.5° relative to true north to align with the local bathymetric contours (onshore, offshore, and alongshore) and to remain consistent with previous alignments….Beyond 500m from the Disposal Site Centre an additional axes will be added midway between those axes (i.e. rotated by -67.5°). "

b. [note: the applicant should confirm that -22.5° is the rotational alignment used from 2013 to 2018]

c. A similar rotation equally applies to locations defined in proposed conditions 2(c).

23 In the Statement of Evidence of Hay (2018), the proposed Consent Conditions have been amended, to now include an Advice Note associated with monitoring station alignment, along with a "Schedule 1", which specifies the specific location of the monitoring sites. The inclusion of the Schedule 1 (if retained) would adequately address my concerns regarding the alignment of the monitoring sites if ALL monitoring and control/reference sites were listed

[9] Page 43 of the Application

[10] e.g. Figure 3.1 of Bioresearches (2017). Post 150,000 m3 Disposal Characterisation of Seabed Changes, November 2015. A report prepared by Bioresearches for Coastal Resources Limited and dated 23 March 2017

therein. (I note that Mr Riddell has proposed other changes to Schedule 1 to include other sites, which will also be of assistance in monitoring the effects of this activity.)

CUMULATIVE WATER COLUMN SUSPENDED SEDIMENT AND TURBIDITY EFFECTS

24 The application advises that approximately of the 1-5%[11] of each dumped barge load is "lost", or in effect becomes suspended within the water column and subjected to passive dispersion processes as material slowly falls to the seabed. I agree with the estimated quantity subjected to such processes. The Application, however did not adequately address the fate of that material.

25 The suspended material 'lost' from the disposal creates a turbid load (sediment plume of increased suspended sediment concentrations) within the water column. This is often referred to as turbidity or suspended sediment. It affects water clarity and, depending upon the concentrations, can have variable effects on both mobile and sessile marine flora and fauna.

26 The Application refers to, and relies on, a single study of suspended sediments at the proposed dumping site (Flaim and de Lange, 2011). It appears that no meaningful further monitoring of suspended sediment within the water column has occurred from 2013 to 2018.

27 It is notable, that the frequency of dumping proposed within the Application represents a considerably greater cumulative sediment load being imposed on the water column (potential for ~1 dumping event per hour) than that monitored by Flaim and de Lange (2011).

28 Flaim and de Lange (2011) report that they monitored 4 dumping events over 15 days, and that in total there were 9 dumping events[12] (over an unknown duration, not the 15 days mentioned earlier). The Application would allow for far more consistent and regular, as well as more frequent dumping events.

29 The conclusions of Flaim and de Lange (2011), and relied on by the Application, are based largely on surface visual observations of the plume due to instrumentation problems, calibration issues, and premature ceasing of the monitoring.

30 In effect suspended sediment plumes extend in a 3-dimensional sense below the surface[13], and are not always visible to a surface-based observer. Flaim and de Lange (2011) did perform some sub-surface monitoring by remote means, via ADCP backscatter data, however those measurements were not well calibrated and ceased prematurely. These are concerning issues with the primary survey of water column turbidity relied on by the Application.

31 The reliance of the Application on a study of limited quantity and quality has resulted in rather imprecise statements within the application in connection with water column turbidity impacts of the proposal, e.g:

[11] Page 28 of Appendix 4 to the Application.
[12] Page 18 of Flaim and de Lange (2011)
[13] e.g. Bernard (1978), Sosnowski (1984), Hayes et al. (1984) in van Rijn, L.C. (2018). Turbidity Due to Dredging and Dumping of Sediments. January 2018.

a. "*The presence of plumes will potentially impact on fish present in the water column. However, the plumes are* ***short lived*** *and the fish and mammals are mobile and able to avoid the plumes*"[14] (emphasis added). There is no clarity on what period of time 'short lived' represents.

b. "*Water quality in the surrounding area is not adversely effected, turbid waters resulting from the disposal plume* ***are not persisting for an extended period of time*** *after a disposal of dredged material has occurred and do not extend beyond the disposal area boundary*" [15], (emphasis added). There is no clarity on what that period of time actually is, nor how turbid the waters are.

32 Though the general conclusion is sound (that the plume is expected to disperse in the order of hours), the conclusion of the Flaim and de Lange (2011) study that *"..this suspension decreased in concentration to background levels, most likely through settling, approximately 1 hour after disposal*"[16] is not appropriate for direct extrapolation in a cumulative sense for the Application. The reason for this is:

a. The frequency of disposal operation, and thereby the sediment load imposed on the water column over time, during the Flaim and de Lange (2011) study is far less than that proposed by the Application;

b. The primary measurement method by Flaim and de Lange (2011) was visual observations from the surface when the plume extends well below the surface;

c. The surveying of Flaim and de Lange (2011) ceased when the surface plume was no longer visible thereby ignoring the persisting sub-surface plume;

d. The placement of sub-surface instruments in the Flaim and de Lange (2011) study resulted in a failure to quantitatively measure (in meaningful turbidity units) the sediment plume; and

e. The imprecise nature of ADCP backscatter data conversion to meaningful turbidity/SSC units for comparison to background levels within the Flaim and de Lange (2011) study.

33 Despite the weaknesses in the primary study relied on for water column sediment plumes, the Application along with the proposed consent conditions do infer that there is an expectation that the suspended sediment plume would be contained within the disposal area. i.e. Consent condition 7(e) requires that:

> "*If the Consent Holder becomes aware of any of the circumstances or events in paragraphs (a) to (g) below:*
>
> ….
>
> *e. The sediment plume (visually observed or determined through monitoring equipment) drifts beyond the boundary of the Disposal area.*
>
> …
>
> *The Consent Holder must notify the EPA by the close of the business day following the Consent Holder becoming aware of such an event.*"

[14] Page 86 of Appendix 5 to the Application
[15] Page 90 of Appendix 5 to the Application
[16] Page 108 of Flaim and de Lange (2011)

34 The effect of suspended sediment upon macro flora and fauna is typically evaluated by means of tests where the biota is exposed to various suspended sediment concentrations over various time periods. The outcome of such tests are dose-response data. No dose-response data or studies have been included within the Application referring to flora/fauna response to elevated suspended sediment concentrations, and whether those concentrations are short lived (periodic) or persist for longer periods of time (chronic). Typically, mobile fauna can avoid intermittent sediment plumes, while other flora and fauna (either sessile, or those without the ability to move in the water column e.g. passive) cannot actively avoid those plumes.

35 After the submission of the Application, and at a very late stage in the EPA process, numerical modelling simulations of suspended sediments resulting from a proposed disposal operation were made available (attached to the evidence of Andrews (2018)). The late provision of those studies has unfortunately only provided only a limited opportunity for review prior to submitter evidence being required for submission.

36 The suspended sediment modelling simulations were based on a disposal method which was not described within the Application. The modelling simulations assumed only 2 barge dumping events per 24 hours, whereas the Application suggested no such restriction.

37 The Statements of Evidence of Hay (2018) and Andrews (2018) indicate that there would be a maximum of 2 barge dumping events per 24 hour period, separated by at least 1 hour[17]. Such an operational control, if supported by appropriate consent conditions, would act to partially mitigate the cumulative effect of the operation on suspended sediments within the water column.

38 I disagree with the statement at paragraph 53 within the Statement of Evidence of Mr David Hay which advises that 1 hour is the time required for turbidity to return to background levels. For the reasons set out in the above paragraphs, I do not consider there is sufficient reliable monitoring data nor evidence to support such a statement.

39 The modelling study indicates that under a scenario with twice daily disposals each of 1,200 m3, that the disposal will contribute 0.03 mg/l of suspended sediment at the boundary of the NDA[18]. In incremental terms or absolute terms, such an increase could be considered as small, however, the result is a model prediction only.

40 When considering a model result, especially one which is not supported by field measurement calibration nor validation, it is worth recalling a quote by American statistician, George Box: "*All models are wrong, but some are useful*"[19].

41 The proposed conditions within the Application, and also those attached to the Statement of Evidence of Hay (2018) do not contain any compliance requirement nor specific scientific monitoring of water column suspended sediment concentrations.

[17] Paragraph 3.0 of the Statement of Evidence of Andrews (2018), and paragraph 53 of the Statement of evidence of Hay (2018), along with proposed consent condition 12 in Attachment 1 of Hay (2018)
[18] Paragraph 6.19(b)(ii) of the Statement of Evidence of Andrews (2018).
[19] Box, G.E.P. (1979). Robustness in the strategy of scientific model building", in Launer R.L. and Wilkinson, Robustness in Statistics.

42 Considering that the information to date is:

a. based on initial studies which were compromised by its approach and were not representative of the operation currently proposed; and

b. computer modelling studies only which have not been appropriately calibrated, validated nor verified with in-situ suspended sediment concentration monitoring results (i.e. without ground truthing)

43 I consider that both a compliance requirement and specific monitoring requirements for water column suspended sediments to be best practice an activity which is introducing large quantities of sediment to the water column.

44 I consider that a compliance limit for suspended sediment should be applied at the boundary of the NDA, and that limit should consider both the modelling result, the non-availability of dose-response relationships for flora/fauna within the area, the ability to be measured effectively, and a sufficient level of precaution. Accordingly, I suggest that such a limit could restrict operation derived suspended sediment concentrations at the boundary of the NDA to say 0.2 mg/l (as indicated by the model result)[20]. Typically, it is preferable to have the limits set in absolute terms as opposed to limits 'above background', as the effect on flora and fauna occurs irrespective of whether the sediment is introduced by natural or anthropogenic means. However, considering the low modelled concentrations and the absence of dose-response effect relationships, an 'above background' approach seems most practical in this case.

45 To address the issue of water column suspended sediment concentrations within the Application, I suggest the following additions to consent conditions, should the committee be of a mind to grant the consent.

Suggested Additional Conditions:

a. The activities authorised by this consent shall not result in …

i. The suspended sediment concentrations at any depth in the water column (from the surface to the seabed) at the NDA boundary increasing by more than 0.2 mg/l relative to background reference concentrations.

b. The monitoring approach for suspended sediments should be outlined within a Schedule attached to a potential Consent (see also the Evidence of Mr Riddell on behalf of the Department). It is my recommendation that the monitoring consider the entire water column (i.e. multiple layers [e.g. 10 m depth bins] from the surface to the sea-bed and also consider locations up-current and multiple down-current from the disposal operation. I consider a frequency of ~once every 5 years for such a monitoring exercise to be appropriate, provided that the monitoring is timed to occur during and immediately after periods when the disposal volume is at its peak over that period.

46 It is not uncommon for operators performing such dredging and disposal works to maintain operational sediment plume models to manage their operation to

[20] [20] Refer to figures 4.13 – 4.24 of Appendix C to the Statement of Evidence of Andrews (2018), and noting that the NDA is a circle with radius 1500 m, along with disposal targets being up to 500 m away from the centre of the NDA.

best ensure compliance to such suspended sediment requirements[21]. Such an approach could be considered as an operational supplement to the proposed turbidity compliance and monitoring conditions.

OTHER AMENDMENTS TO THE PROPOSED CONDITIONS OF CONSENT IN THE EVIDENCE OF HAY (2018)

47 In the Statement of Evidence of Hay (2018) a set of proposed consent conditions were provided as Attachment 1. Those conditions differed from the conditions provided within the Application. In addition to those suggested changes identified in the above paragraphs, within the brief time allowable, I have initially reviewed those revised consent conditions and suggest the following clarifications (condition referencing it to those listed in the Statement of Evidence of Hay (2018) unless otherwise noted):

48 Proposed Consent Condition 5(b), before "*sediment size class*" insert "*Any standard (i.e. Udden-Wentworth)…*" and make reference to the sediment size class scale (e.g. wentworth, phi, etc.), in order to ensure that the sediment size class reference is precise and consistent for the duration of the consent. This will ensure that the same size range is used to define the sediment classes (in units of mm and μm), which is essential for the compliance evaluation of this condition over the duration of the consent.

49 Proposed Consent Condition 8(b) and 8(c) refer to the 17 monitoring sites listed within Schedule 1 only. Schedule 1 sites do not include any control nor reference monitoring sites. I consider the monitoring of control sites for both contaminants (8b) and grain size distribution (8c) to be essential for a well-planned monitoring program, and in line with best practice. Accordingly, I recommend that reference/control sites which ARE NOT anticipated to be affected by the operation, and which exist in similar water depths and sediment type be added to Schedule 1.

50 Within the Application, the proposed consent conditions included a requirement for multi-beam bathymetric monitoring of the NDA[22]. There is no similar requirement within the consent conditions proposed within the Statement of Evidence of Hay (2018). It is irregular that such an operation, which over the duration of the consent may result in seabed elevation changes exceeding[23] 3 m in vertical elevation, does not monitor and measure the shape and form of the three-dimensional mound on the seabed. Survey precision could be increased to ensure measuring the mound, rather than deleting the requirement entirely. I recommend that an appropriate level of bathymetric survey be included within the monitoring requirements.

51 Within the Application, the proposed consent conditions included Condition 6, which required that the Consent Holder notify the EPA and, in some cases, take additional measures (e.g. suspend operations) in the case that the Consent Holder became aware of events which had high potential to materially affect the physical, ecological, or chemical effects at the dumping site. An equivalent condition is not present with the conditions attached to the Statement of

[21] e.g. Decrop and Bollen (2016). Innovative Simulation Tools for Turbidity Management. Proceedings of the 21st World Dredging Congress and Exhibition (WODCON XXI), Miami, Florida, June 13-17 2016.
[22] Proposed Condition 2 (a) of the Application.
[23] Table 4 of the Application indicates that seabed elevation change may reach 3-3.75 m over the duration of the 35 year consent.

Evidence of Hay (2018). The Application's Condition 6 presented an appropriate course of action and risk mitigation in relation to events which cannot be fully foreseen nor anticipated at the time of consent issuance. Examples of such unforeseen, indirect, and infrequent events which I have experienced in the past are flooding and industrial fires within the catchment area surrounding the dredging works, whereby the run-off from those events can carry substances which have potential to affect the chemistry of the surficial sediments being dredged. Such events are not directly associated with the works, are infrequent, and unforeseen and I consider that the Condition 6 within the Application represented an appropriate way to address those. I recommend that condition be re-instated.

52 Schedule 2. Appendix 5 of the Application sets out the general approach for chemical characterisation of sediments prior to dredging and disposal. In particular it is notes that "*Testing for metals and inorganic and organic compounds listed in Table 2.6 will be required if a particular source of such contamination at the site where the waste is generated is identified. … For most New Zealand harbours, this will include heavy metals and metalloids (arsenic, cadmium, chromium, copper, lead, mercury, nickel, zinc) as a minimum, with the addition of organic contaminants such as total petroleum hydrocarbons (TPH), polynuclear aromatic hydrocarbons (PAH), organochlorine pesticides, tributyl tin and other antifouling compounds on a case by case process as indicated by the level 1 assessment*".[24] Polynuclear aromatic hydrocarbons (PAH), and organochlorine pesticides are not included within the list of compounds identified within Schedule 2 of the statement of Evidence of Hay (2018). Polynuclear aromatic hydrocarbons are found in coal, tar, and are produced by incomplete combustion (e.g. within vehicles or land clearing). Given the prevalence of road runoff to coastal and marine sediments, along with vessel based combustion engines within harbours and marinas, I recommend that PAH be added to the mandatory list of Schedule 2 compounds.

53 Schedule 2. The compounds and elements listed in Schedule 2 should be identified clearly that these are the Primary (or mandatory) contaminants for analysis only. To clarify this, a statement could be added at the end of Schedule 2 to highlight that additional parameters are to be tested in accordance with the process set out in Schedule 3.

Dated: 31 October 2018

Peter Longdill

[24] Refer to paragraph 5, page 14 of Appendix 5 of the Application.