Department of Planning and Environment

Rachel Snape
Planning and Development Manager (NSW/ACT)
Boral Resources (NSW) Pty Ltd
39 Delhi Road
North Ryde NSW 2113

24 February 2022

Dear Ms Snape

Subject: Stockton Sand Quarry (SSD 9490) Response to Request for Information

I refer to your Response to Request for Information submitted to the Department of Planning and Environment (the Department) on 16 December 2021. The Department considers additional information is required.

The Department seeks additional information regarding the:

- accuracy of geology and stratigraphy used to exclude the RZM project outcomes from further consideration
- connectivity of the Stockton Sandbeds with the Tomago Sandbeds
- presence of mineral sands in the Stockton Sandbeds
- historical mineral sands mining undertaken by Mineral Deposits Limited (MDL) within the Stockton Quarry site area and subsequent groundwater impact
- similarities between the impact of the MDL and RZM projects on groundwater
- adequacy of the acid sulphate soils assessment and the potential for the assessment to underestimate the presence of potential acid sulphate soils (PASS)
- the assessment of heavy metal mobilisation and consideration of complex causes of oxidation
- suitability of progressive sampling and investigation of acid sulphate soils (ASS) once dredging has commenced and potential for delayed heavy metal mobilisation

Further detail and explanation of the Department's comments are provided in **Attachment A**.

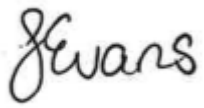
The Department requests that Boral provides the following information:

- detailed regional geological information and a site specific geological/stratigraphic profile
- information detailing historical mineral sands mining undertaken by MDL within the Stockton Quarry boundary
- analysis of hydrogeochemical similarities between the MDL and RZM projects and an assessment of the risk of a similar outcome from the proposed dredging project
- an analysis of available groundwater results collected at the Stockton Quarry site and an assessment of the potential for heavy metal mobilisation
- justification of sampling rates and methodologies used to assess ASS
- a review of the field testing results for PASS
- justification of the methodology used to assess natural buffering, and an analysis of the results without the inclusion of natural buffering capacity
- further assessment of potential hydrogeochemical reactions and current redox environment

- detailed analysis of how progressive ASS sampling and investigations would respond to the risk delayed mobilisation of heavy metals

The Department notes that the Department of Planning and Environment – Water (DPE Water) and the Natural Resources Access Regulator (NRAR) may provide additional comments which will be appended to this request.

Yours sincerely,



Jessie Evans
Director
Resource Assessments

Attachment A

Detailed review and request for information – Response to Request for Information Stockton Sand Quarry (SSD 9490) December 2021

Geological Profile

Request for Information - *The Department requests further assessment of detailed regional geological information. A site specific geological/stratigraphic profile is also required to understand the depths, distribution and properties of the sand which would be disturbed by the proposed dredging operations, the likelihood of oxidation occurring and the risk of heavy metal groundwater contamination occurring as a result.*

Relationship with RZM Project

The Stockton Quarry: dredging project - Response to request for Information December 2021 (Response to RFI) states: *'it is noted that the mineralogy associated with the earlier Rutile and Zircon sand mining undertaken to the north is completely unrelated to the Boral site.'*

The Department accepts that the Stockton and Tomago Sandbeds are different ages but considers that the geology and soil profile of the Rutile and Zircon sand mine (RZM) is not unrelated to the Stockton Quarry site and shares enough similarities to be relevant.

The age of the Stockton Sandbeds does not preclude the formation of ASS. The Response to RFI identifies that ASS may be: *'deposited during either the Pleistocene or Holocene geological epochs (Quaternary period) as sea levels rose and fell.'*

Geological Profile

The Stockton Sand Quarry Dredging Environmental Impact Statement 2020 (2020 EIS) provides a general geological cross section (based on Thom et al.,1992) through the Tomago-Stockton Sandbeds, which illustrates of the Tilligerry Mud Member/marine estuarine sands and muds to the seaward extent.

Woolley et al., 1995 notes that the Tomago Sandbed continues to the east under the Stockton Sandbeds and is part of the same geological structure, with differentiation between the Tomago Sandbed and the overlying sand beds not being possible in all places. Woolley et al., 1995 states that the seaward extent of the Tilligerry Mud member is limited but limits are uncertain and where it is absent, there is presumed hydraulic connectivity between the Stockton Sand Member and Tomago Sand Member. Woolley et al., 1995 also noted the groundwater ionic chemistry of the two sand members is not distinguishable and holds the same properties.

The 2020 EIS and Response to RFI do not provide a geological profile for the site which adequately identifies and assesses the stratigraphy which would be disturbed by the proposed operations.

The Department also notes grey sand units (including dark grey) and coffee rock horizons are noted in the Response to RFI and 2020 EIS. Borelogs also identify high levels of shell content, with some up to 50% of the sand content. Further information on the contribution of these to ASS/PASS and the implications for to project to extend into the underlying stratigraphy is needed.

Historical mineral sand mining and groundwater impact

Request for Information – *The Department requests further information detailing historical mineral sands mining undertaken by Mineral Deposits Limited (MDL) at the Stockton Quarry site. The information should include detailed groundwater monitoring data collected before and after MDL's dredge passed, details of investigations undertaken following impacts being identified and any remediation undertaken by MDL at the site.*

Mineral Sand Presence

The Department notes that mineral sand is present in the Stockton Sandbed. Mineral sand mining has operated in at least two locations:

- MDL's mineral sand dredging operation at Stockton Quarry between 2002 and 2003, and
- Immediately north to the site at the Newcastle Bight Dunes (MDL, 1977)

Mineral Deposits Limited – Dredging Project

The 2020 EIS identifies that dredging was undertaken by MDL from August 2002 to July 2003 under a development consent granted by Port Stephens Council. The 2020 EIS and Response to RFI provide very limited discussion of MDL's historical project at the site.

The Stockton Sandpit Windblown Sand Extraction Environmental Impact Statement (ERM, 2005) (2005 EIS) details dredging was undertaken by MDL over 11 months to – 4 m below the standing groundwater level and involved the separation of the heavy mineral fraction (rutile, ilmenite, and zircon) before reinstating the dune mass. Dredging took place within the same footprint as the currently operating Stockton Windblown project approved under DA140-6-2005.

The hydrogeological impact assessment included in the Response to RFI states: '*No significant physical or chemical impact to groundwater as a result of sand extraction was identified during previous site investigations.'*

The Department notes that the previous site investigations reviewed (refer to Table 4, Summary of relevant reports – Hydrogeological assessment report) did not include information pertaining to MDL's historical operations at the Stockton site.

Groundwater Impact

Request for Information - *The Department requests an analysis of the hydrogeochemical similarities between the MDL and RZM project impacts and an assessment of the risk of a similar outcome from the proposed dredging project.*

Data included in the 2005 EIS identifies changes to groundwater chemistry following the completion of MDL's dredging project. The 2005 EIS acknowledges that mining by MDL resulted in an impact to groundwater quality with elevated levels of iron and arsenic recorded in the vicinity of the dredging project along with changes to electrical conductivity, pH and chlorine.

Average iron levels increased to four times the pre-dredging levels. Arsenic concentrations ranging from 0.007 to 0.02 mg/L were recorded following dredging. Arsenic had not previously been recorded in groundwater during the six-year sampling period completed prior to MDL's operations commencing.

The project proposes to dredge at -15 m AHD which is a similar depth to the 'deep' mining undertaken at RZM project which resulted in greater groundwater impacts in comparison to the shallow mining depths.

Mobilisation of metals and metalloids in groundwater at Stockton Quarry site

Request for Information – *The Department requests an analysis of available groundwater results collected at the Stockton Quarry site and an assessment of the potential for heavy metal and metalloid mobilisation as a result of the proposed dredging project noting the impact (ERM, 2005) which resulted from MDL's dredging operation. The assessment should consider the potential for more complex oxidation processes.*

The Response to RFI includes groundwater data collected between July 2017 and March 2021 which identifies iron and zinc in all groundwater wells as well as aluminium in several. The Response to RFI attributed the elevated levels to natural variation, with the hydrogeological impact assessment predicting that the consistent chemistry of groundwater observed to date would continue throughout the operation of the proposed dredging project.

The elevated dissolved metal and metalloid concentrations reported in the 2021 Annual Environmental Management Report for Stockton Quarry (R.W Corkery, 2021) may not be attributed to the operations of current Stockton Quarry Windblown project, however, it's possible that the mobilisation of metals and metalloids in groundwater at the site are potentially the result of or influenced by the MDL dredging project, demonstrating the potential for groundwater contamination as a result of dredging activities in the Stockton Sandbed.

Soil samples collected within the proposed extraction footprint demonstrate the availability of iron and arsenic in the soil within the proposed extraction footprint. The sample rate of 1 sample per 1.68 hectares has the potential to underestimate the presence of heavy metals in soils within the proposed extraction footprint.

Acid Sulphate Soils

Request for Information – *Address the requirements for acid sulphate soils assessment detailed in the Acid Sulfate Soils Manual 1998 (Stone et al., 1998) (ASS Manual) and outlined below. Provide justification for the deviation from sampling rates and methodologies listed in the ASS Manual for a project with high risks identified and assess the impact of the deviations on the representativeness and conclusions of the ASS Assessment included in the Response to RFI.*

ASS Sampling Program

The Department notes that Boral completed an additional 7 boreholes in response to DPIE Water's advice, bringing the project total to 11. Low borehole and sampling density and testing for the proposed impact area creates a risk of underestimating the presence of PASS, particularly if pyrite was heterogeneously dispersed in a similar manner to the RZM Project. An example, is the recommendation for a minimum 2 boreholes per hectare for proposals with a site area of more than 4 Ha (equating to 74 boreholes for the proposed impact area).

Field and Laboratory Testing for Potential Acid Sulphate Soils

Request for Information - *Provide a review of the field testing results for PASS and the selection of samples for laboratory testing compared to the requirements of the ASS Manual 1998.*

The ASS Manual (1998) describes a positive peroxide test as including one but preferably more of the following: change in colour of the soil from grey to brown tones; effervescence; the release of sulfur smelling gasses; a lowering of pH by at least one unit; and a final pH <3.5 and preferably pH <3.

The ASS Assessment appears to focus on the pH^{FOX} values and does not consider the other criteria listed above, particularly the lowering of pH by at least one unit.

Natural Buffering

Request for Information - *The Department requires further discussion of the methodology used to assess natural buffering with a view to the guidance provided in the Acid Sulfate Laboratory Methods Guidelines (Ahern et al., 2004) and the evidence from the RZM project which determined that natural buffering did not occur. Boral should also provide an analysis of the ASS Assessment results without the inclusion of natural buffering capacity.*

The Response to RFI concluded:

"All soils analysed were classified as Not Acid Sulphate Soils (NASS) or Non-Reactive (NRNR). Soils classified as 'no sulphur' are NASS, while 'non-reactive' (NRNR) soils are completely self-buffering and do not require management through neutralization if oxidized (although they do require monitoring).

Given the above, it is reasonable to extrapolate that a natural buffering capacity exists across the project area due to the presence of shell grit (CaCO3) within sand deposits. EES have drawn the reasonable conclusion, based on the data collected from the incubation assessment in particular, that the natural buffering capacity measured in the laboratory can be replicated at field-scale and therefore can be relied upon."

The Acid Sulfate Soils Laboratory Methods Guidelines (Ahern et al. 2004) notes the following:

- effectiveness of buffering components in maintaining soil pH at acceptable levels (e. pH 6.5-9.0) depends on the types and quantities of clay minerals in the soil, and on the type amount and particle size of the carbonates or other minerals present
- presence of carbonates, in excess of the potential acidity held by sulfides, does not necessarily prevent soil acidification if the carbonates' acid buffering is not readily or rapidly available (e.g. if it is locked up in shells)
- it is extremely important to know the *in situ* form and distribution of carbonates in the sediment to enable correct interpretation of analytical results
- many of the acid sulphate soils in Australia the amounts of shell deposits, carbonates or clay buffering capacity are insufficient to neutralise the acid produced by pyrite oxidation. Shells would need to be occurring in powdered form such as erosion of limestone cliffs or reef debris

As noted by DPIE Water, Coffey (1996) concluded that the presence of shells did not buffer the acid production of the oxidisation process at the RZM Project.

Chip Tray Incubation

Request for further information - *Provide further discussion and justification of the chip tray incubation methodology and conclusions including a comparison with the recommendations of the National acid sulphate soils identification and laboratory methods manual (Sullivan et al., 2018).*

The Response to RFI includes a chip tray incubation test to assess the reliability of the natural buffering capacity. The Department notes that the National Acid Sulphate Soils Guidance – Chip-tray incubation – NLM-8.2 methodology requires a minimum 9-week incubation with samples between pH 4 and pH 6.5 continuing to 19 weeks.

The National acid sulphate soils identification and laboratory methods manual states if a pH of <6.5 is recorded at any time during the experiment, Acid Neutralising Capacity (ANC) cannot be included in the determination of Net Acidity.

Groundwater chemistry indicators of PASS

Request for Information - *Further assessment of the potential for hydrogeochemical reactions and current redox environment at the site.*

The RZM and MDL projects demonstrate that complex hydrogeochemical reactions resulted from the dredging process causing the dissolution of metals into groundwater.

Groundwater Data

A hydro geochemistry summary is provided in Table 15 of the Hydrogeological assessment report with 20 groundwater wells sampled on 23 or 24 April 2018. In comparison, results for inorganic chemistry and dissolved metals are only provided for 10 groundwater wells over 19 sampling rounds. The ASS Manual details the need for a systematic sampling strategy to understand a water body and its' vulnerability to impacts. An appropriate number of sample locations and frequency should be designed to suit the scale of the proposed works, the characteristics of the water body and the nature of the potential impact.

Indicators of Reduced Inorganic Sulfur

Data from one sampling round of MW_X3 shallow and deep is provided in the hydrogeological impact assessment. The data is not considered to be representative of the site conditions. Additional data for oxidation-reduction potential (ORP) and dissolved oxygen over a longer period should be included.

Cl^-/SO_4^{2-} Ratio

The Response to RFI presents very limited results for the Cl^-/SO_4^{2-}. The results gathered from one sampling round range from 0.6 to 87. The ASS Manual states a '*Cl^-/SO_4^{2-} of less than four and certainly less than two, is a strong indication of an extra source of sulfate from previous sulfide oxidation.'*

The Response to RFI ASS Assessment does not include a discussion of the oxidising/reducing environment present in the groundwater or an assessment of the Cl^-/SO_4^{2-} results.

Mitigation and Management

Request for Information – *Provide further detailed analysis of how progressive ASS sampling and investigations would respond to the risk of delayed mobilisation of heavy metals.*

The Response to RFI proposes to undertake progressive ASS sampling and investigations ahead of extraction operations in the later stages of the project. The Department notes that the impact of the RZM project was not immediate, with increases in iron levels taking approximately 15 months after deep mining to reach the maximum (Coffey, 1996).

References

Ahern CR, McElnea AE, Sullivan LA (2004). Acid Sulfate Soils Laboratory Methods Guidelines. Queensland Department of Natural Resources, Mines and Energy, Indooroopilly, Queensland, Australia.

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Coffey (1996) Data Review and Assessment of Hydrogeological and Hydrogeochemical Impacts of Heavy Mineral Mining on the Tomago Sandbeds, Newcastle, NSW – The Steering Committee – Draft Report No.1

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R.W Corkery (2021) 2020 Annual Environmental Management Report for Stockton Transgressive Dune Quarry

Stone, Y, Ahern C R, and Blunden B (1998). Acid Sulfate Soils Manual 1998. Acid Sulfate Soil Management Advisory Committee, Wollongbar, NSW, Australia

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Woolley, D et al. (1995) Tomago Tomaree Stockton Groundwater: Technical Review