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7 August 2025
Project No. J0724-014-006 Rev1

Holcim (Australia) Pty Ltd
Northpoint Tower, Level 40, 100 Miller Street,
North Sydney NSW, 2060

Attention: Marian Higgins
Planning Approvals Manager NSW & ACT

RE: Acid Sulfate Soil Statement Advice, 8 Oakvale Drive, Salt Ash, NSW, 2318

1.0 INTRODUCTION

Holcim (Australia) Pty Ltd (Holcim) engaged Dr Silvana Santomartino from PSK Environmental Pty Ltd (PSK) to undertake a peer review of the Acid Sulfate Soil (ASS) investigation report prepared by Geosyntec Consultants (Geosyntec) for the Holcim Salt Ash Sand Operations ('the Project') located at 8 Oakvale Drive, Salt Ash, New South Wales (NSW), known legally as Lot 4 DP 774726 ('the Site'). Mr Josh Mitchell from Core Consultants was engaged by PSK as the internal reviewer of PSK deliverables.

The following Draft reports by Geosyntec were reviewed by PSK:

- Geosyntec Consultants (2024a) *Draft Acid Sulfate Soil Dat Gap Investigation, 8 Oakvale Drive, Salt Ash, NSW, 2318*, Doc. Ref. AU122186 R02. 31 May 2024.
- Geosyntec Consultants (2024b) *Salt Ash Kinetic Column Leach (KCL) Test Interim Results*, Doc. Ref. AU122186B L01. 8 October 2024.

PSK then prepared a review of the Draft reports and issued a report of the findings/feedback:

- PSK Environmental Pty Ltd (2024a) *Holcim Salt Ash Maximisation Project – Acid Sulfate Soil Technical Review*, 25 October 2024, Project No. J0724-014-001 Rev0.

Geosyntec addressed the PSK findings/feedback in their final draft report:

- Geosyntec Consultants (2024c) *Final Draft Acid Sulfate Soils Characterisation Investigation, 8 Oakvale Drive, Salt Ash, NSW, 2318*, Doc. Ref. AU122186 R02. 29 November 2024.

PSK's prepared a final review report based on the final Geosyntec ASS Investigation Report:

- PSK Environmental Pty Ltd (2024b) *Holcim Salt Ash Maximisation Project –Technical Review – Final Draft Acid Sulfate Soil Characterisation Investigation*, 8 Oakvale Drive, Salt Ash, NSW, 2318, 18 February 2025 Job Number. J0724-014-003 Rev0.

Geosyntec issued a final report:

- Geosyntec Consultants (2025) *Acid Sulfate Soils Characterisation Investigation, 8 Oakvale Drive, Salt Ash, NSW, 2318*, Doc. Ref. AU122186 R02. 28 February 2025.

2.0 OBJECTIVES

The objective of this statement advice is to advise whether the ASS investigations completed for the Site are considered sufficient to inform an ASS Environmental Management Plan (ASS EMP) for fines.

3.0 FINDINGS OF REVIEW OF GEOSYNTEC ASS CHARACTERISATION REPORT

The key findings of the reviews are summarised in **Table 1** with reference to the following ASS guidelines:

- Stone, Y., Ahern, C.R., and Blunden, B. (Eds.). (1998). *Acid Sulfate Soils Manual*. Wollongbar, NSW: Acid Sulfate Soil Management Advisory Committee (ASSMAC).
- Sullivan, L, Ward, N, Toppler, N and Lancaster, G 2018a, National Acid Sulfate Soils guidance: National acid sulfate soils sampling and identification methods manual, Department of Agriculture and Water Resources, Canberra ACT. CC BY 4.0. ('National ASS Sampling Guidelines')
- Sullivan, L, Ward, N, Toppler, N and Lancaster, G 2018b, *National Acid Sulfate Soils Guidance: National acid sulfate soils identification and laboratory methods manual*, Department of Agriculture and Water Resources, Canberra, ACT.
- Simpson, SL, Mosley, L, Batley, GE and Shand, P 2018c, *National Acid sulfate soils guidance: Guidelines for the dredging of acid sulfate soil sediments and associated dredge spoil management*, Department of Agriculture and Water Resources, Canberra, ACT. CC BY 4.0.

Table 1. Reviewer Comments on ASS Investigations Completed with Reference to the ASS Guideline Requirements.

Relevant ASS Guideline Requirement	ASS Investigations Completed	Reviewer Comments
Sampling Density		
The proposed disturbance footprint of the Salt Ash Site is approximately 35.37 ha, encompassing all areas to be disturbed including internal access roadways, processing operations and vegetation clearing. The *NSW Acid Sulfate Soils Manual* (ASSMAC 1998), which is considered the best practice guideline for assessing ASS in NSW, requires an investigation frequency of two boreholes per hectare for areas larger than 4 ha. Based on the on this, a total of 71 boreholes would be required for the Salt Ash Site. The National acid sulfate soils sampling and identification methods manual (Sullivan et al. 2018a), referred herein as the 'National ASS S*ampling Guideline*' allows a reduced sampling frequency for projects greater than 20 ha, providing the investigation program can be clearly demonstrated to have satisfactorily characterised the various geological/geomorphological units at the site.	The following boreholes have been drilled at the Site: • GeoTerra (2022) advanced six boreholes (BH) with samples for ASS testing collected to a depth of 15 m below ground level (bgl). One of the six boreholes was located within the disturbance footprint. • Geosyntec advanced 29 boreholes to a maximum depth of 36 m. Of the 29 Geosyntec locations, 24 boreholes were advanced within the disturbance footprint (BH101 to BH124), and five boreholes outside of the disturbance footprint (BH125D, BH126D, BH127D, BH128D & BH129D). The majority of the Geosyntec boreholes were advanced to a depth of more than 1 m below the proposed disturbance depth. Therefore, a total of 35 boreholes have been drilled at the Site to recover ASS samples. Geosyntec stated the incremental refinement in the representativeness of each borehole was minor above approximately 10 ha. At 2 boreholes per hectare (60 boreholes over 30 hectares) each borehole represents 1.7% of the site, versus 2.9% of the site per borehole for the completed drilling program. Geosyntec considered that the investigation density provided sufficient spatial coverage based on: • the observed consistency in stratigraphy encountered during drilling.	PSK has concluded that sufficient soil data has been collected from soils located below the groundwater table given the following: • There is consistency in the field and laboratory data with the D1/D2 layer consistently returning higher concentrations of pyrite than other soil layers. There is also consistency in the pyrite concentrations reported for the remaining layers: D1, D2 and D3. There is good correlation between data obtained from GeoTerra and Geosyntec investigations. • Qualitative analysis (i.e. field screening) was undertaken on samples collected at intervals of 0.5 m and quantitative analysis (i.e. Chromium Reducible Sulfur [CRS]) was undertaken generally on samples collected at 1 m intervals in the D1, D2 and D3 layers and every 0.5 m in the D1/D2 layer during the Geosyntec assessment. All geological/geomorphological units to be disturbed have been sufficiently characterised. • After hydro-cycloning, the stockpiled sand will require re-sampling to assess its final acidity status. The frequency of this sampling is outlined in the ASS EMP. • Data from BH7 (GeoTerra 2022) was compared with data from the nearest Geosyntec borehole (BH104). There is good correlation in the data collected from BH7 and BH104 with similar net acidity values obtained where these were available. • Data from BH6 (GeoTerra 2022) was compared with data from Geosyntec borehole BH125. The data is strongly correlated with an absence of the highly acidic D1/D2 layer in both boreholes. In general, the Geosyntec and GeoTerra (2022) results are consistent. Both detected higher concentrations of pyrite within the mixed unit D1/D2 than any other unit.

Relevant ASS Guideline Requirement	ASS Investigations Completed	Reviewer Comments
	• the consistency in field pH_F and pH_{FOX} results vertically within the geological units and laterally between boreholes. • the consistency in laboratory analytical results vertically within the geological units and laterally between boreholes.	In summary, while the investigation frequency was not in accordance with ASSMAC 1998, based on the frequency of boreholes below the groundwater table, the ASS in the geological/geomorphological units has been sufficiently assessed PSK has concluded that insufficient soil data has been collected from soils located above the groundwater table given the following: • GeoTerra (2022) conducted ASS testing on samples located above the groundwater table, but data is available for samples from only six boreholes. In addition, the samples were composited for laboratory testing which does enable an appropriate liming regime to be developed, nor does it meet the sample handling requirements specified in ASSMAC 1998, nor the *National ASS Sampling Guideline* (Sullivan et al. 2018a). • Geosyntec commissioned laboratory analysis on samples located below the groundwater table (i.e., at depths below approximately 2 m bgl to 4 m bgl). As a result, soils above the groundwater table, but still located at, or below 5m AHD, have not been assessed for ASS. A data gap exists as soils located below 5m AHD have not been assessed as per the requirements of ASSMAC 1998, nor the *National ASS Sampling Guideline* (Sullivan et al. 2018a). The ASS regime in the unsaturated zone on the Salt Ash Site, therefore, has not been sufficiently assessed. However, this will be undertaken during the operational phase of the project. It is understood that the sampling regime was communicated to staff from the Department of Planning, Housing and Infrastructure (DPHI), NSW Environment Protection Authority (EPA), Hunter Water Corporation and Department of Climate Change, Energy, the Environment and Water (DCCEEW) during a meeting on 21 November 2023, and during a second meeting with DPHI on 21 November 2023.

Relevant ASS Guideline Requirement	ASS Investigations Completed	Reviewer Comments
ASS Analysis		
The analytical suite for the assessment of ASS as required by the *National ASS Sampling Guideline* (Sullivan et al. 2018a) is: • Field pH (pH_F) • Field pH peroxide test (pH_{FOX}) • Chromium Suite: ➢ Chromium Reducible Sulfur (S_{CR}) or ➢ Peroxide Oxidisable Sulfur (S_{POS}) ➢ KCl Extractable pH (pH_{KCl}) ➢ Titratable Actual Acidity (TAA) ➢ Net Acid Soluble Sulfur (S_{NAS}) ➢ Acid Neutralising Capacity (ANC) • Acid Volatile Sulfide (AVS) if monosulfides are anticipated. • Slab incubation, or Chip Tray Incubation	The following analytical program was completed by Geosyntec. • Field & laboratory pH (pH_F) • Field & laboratory pH peroxide test (pH_{FOX}) • Chromium Suite: ➢ S_{CR} ➢ pH_{KCl} ➢ TAA ➢ S_{NAS} ➢ ANC • Scanning Electron Microscopy • Carbon Speciation (inorganic, organic carbon) • X-Ray Fluorescence (XRF) • X-Ray Diffraction (XRD) Chip tray/slab incubation testing was not undertaken on the samples. Geosyntec states that '*Long term kinetic column leaching assessment in accordance with AMIRA 2002 has been completed. It is noted that Sullivan et al. (2018a) recommend that chip tray analysis is used to assess for available acid neutralising capacity. Kinetic column leach tests (exceeding the minimum 21 weeks required) were adopted for ANC characterisation as the columns allow for the calculation of sulfur depletion rates and the assessment of potential risks to groundwater through determination of potential contaminants released during pyrite oxidation*''	PSK concluded that sufficient information has been obtained with respect to soil, to develop an ASS EMP for fines. The following was noted: • All the standard, best practice ASS analytical methods were completed. • The Chromium Suite was selected in preference to the Suspension Peroxide Oxidation Combined Acidity and Sulfur (SPOCAS) suite which is appropriate given the presence of organics within D1/D2 layer. • AVS was not completed but this is acceptable given that black iron monosulfidic oozes are not anticipated in this environment and black oozes were not observed in the field, based on the field logs and photographs included in the report. • To corroborate the ANC effectiveness, Geosyntec used the results from the KCL assessment rather than slab incubation or chip tray testing. Based on the KCL results, Geosyntec corroborated ANC in the D3 layer only. Whilst not conventional, this is considered an acceptable approach for the D3 layer and was expected given that there was often three times more ANC than total (potential + actual) acidity in samples from the D3 layer. Nevertheless, the corroboration of ANC for this project is considered irrelevant given that the wet screen will separate large shells (>1mm) from the sand and the hydro-cycloning process will result in an unknown distribution of ANC throughout the sand and fine fractions.

Relevant ASS Guideline Requirement	ASS Investigations Completed	Reviewer Comments
The analytical suite for the assessment of leachability as required by the *National ASS Sampling Guideline* (Sullivan et al. 2018a) is: • Leaching assessment using Sequential Metals and Metalloid Extraction, or • Elutriate Testing	The following analytical program was completed by Geosyntec. **Leach** • Elemental content using aqua regia digest • Leaching assessment using Australian Standard Leaching Procedure (ASLP) • Leaching Environmental Assessment Framework (LEAF) Method 1313 • Long-term Kinetic Leach Columns (KCL) assessment.	PSK concluded that whilst a detailed leach analysis was completed, further understanding is required on the leachability of metals under site specific conditions (refer below). The following was noted: • The leaching tests nominated by the guidelines were not adopted; however, other leach tests were undertaken. As discussed further below, the study could have benefited with more site-specific leach test. Elutriate testing assesses impacts to water quality. The elutriate test is designed to simulate release of contaminants from a sediment during dredged material disposal. Release can occur by physical processes (e.g. directly from sediment pore water) or a variety of chemical changes, such as oxidation of metal sulfides and release of contaminants adsorbed to particles or organic matter (*National Assessment Guidelines for Dredging 2009*).
	Aqua regia digest using a strongly acidic composition indicated that aluminium (Al), arsenic (As), barium (Ba), beryllium (Be), chromium (Cr), cobalt (Co), copper (Cu), iron (Fe), manganese (Mn), molybdenum (Mo), nickel (Ni), lead (Pb), strontium (Sr) and zinc (Zn) were present in the soil matrix. However, as documented by Geosyntec, the test provides a conservative estimate of the soil-bound metals and metalloids that could be mobilised from ASS when soils are exposed to strongly acidic conditions (less than ~pH of 1.5). An initial quantification of the metal and metalloid leachability of these elements was assessed via adoption of the Australian Standard Leaching Procedure (ASLP) method, with de-ionised water as the leach fluid, and the Leaching Environmental Assessment Framework (LEAF) 1313 method. The	Based on the testing completed, it is uncertain whether metals will be released at neutral pH. Whilst the leach testing results indicate that metal leachability is lowest for most metals at near neutral pH, a better understanding of metal leachability under site-specific conditions is required to more accurately assess potential impacts to groundwater. The starting pH of the ALSP test was not provided in the Geosyntec report therefore the results cannot be accurately interpreted with respect to the Site. Both ASLP and LEAF 1313 testing requires tumbling of soil solutions for ≥24 hrs. This is unlikely to be representative of site conditions. The samples used in the KCL experiments had oxidised prior to commencement of the experiments; therefore, the reliability of the test results, with respect to reaction kinetics, is reduced. Additional testing will be undertaken during early works on *in situ* ASS to assess the mobility of metals and metalloids in the dredged

Relevant ASS Guideline Requirement	ASS Investigations Completed	Reviewer Comments
	results indicated that when the soils came into contact with water, measurable concentrations of metals were released from the soils despite the large liquid to solid ratio used (solid: liquid, 1:20). The suite of elements with measurable concentrations in the ASLP were Al, As, Ba, Co, Fe, Mn, Ni, Pb, Sr and Zn. Of these, Al, Fe and Mn were the elements leaching at the highest concentrations. Iron concentrations from D1/D2 were reported at very high levels (26 000 mg/L). KCL experiments were undertaken over a minimum period of 21 weeks.	sediments under site-specific conditions. This includes further analysis such as elutriate testing as per the *Guidelines for the dredging of acid sulfate soil sediments* (Simpson et al. 2018) and the *National Assessment Guidelines for Dredging 2009.* The Groundwater Management Plan (GWMP) developed for the Site (ENV Solutions 2025) provides guidance relating to testing of fines to assess metal leachability.
Data Quality		
The *National ASS Sampling Guideline* (Sullivan et al. 2018a) requires a quality control ratio of one duplicate sample per 20 primary samples. Triplicates are not required by the *National ASS Sampling Guideline* (Sullivan et al. 2018a).	Based on the Geosyntec report, 106 duplicate or triplicate soil samples were collected and analysed along with the 946 primary soil samples that were analysed for either ASS screening or by the Chromium Suite. The 106 duplicate or triplicate soil samples included samples resubmitted for analysis. Geosyntec states that of the total 946 individual analyses for the 106 primary samples for which replicates were collected, a total of 47 exceeded the relative percent difference (RPD) criterion of 50%, representing a 95% compliance rate for the RPD analysis which is an acceptable QC outcome for the soil analytical program.	The Geosyntec assessment exceeds the required quality control ratio as triplicate samples were taken in addition to duplicate samples. PSK performed random RDP calculation checks on 10% of the data. RPD calculations were correct. Most RPD failures occurred within screening ASS results rather than the Chromium Reducible Sulfur (CRS) results, indicating that the CRS results obtained a low RPD failure rate. This is favourable given that the management measures are based on net acidity results of the CRS method. Failures in the ASS screening result are expected given that the results are indicative only.

Relevant ASS Guideline Requirement	ASS Investigations Completed	Reviewer Comments
Sample Handling		
The National ASS Sampling Guideline (Sullivan et al. 2018a) states that it is preferable that samples reach the selected laboratory within 24 hrs of collection. For transport and short-term storage during transit, samples should be kept chilled and stored in an insulated container so that they reach the laboratory at less than 4 °C.	Geosyntec stated that the samples were frozen upon collection and were dispatched frozen to the laboratory. However, holding time exceedances were identified on the laboratory sample receipt advice notifications (SRN) for soil samples. For example: • Enviro lab Batch 340430, stated holding time exceedance for samples submitted for ASS screening. Stated that ice was present and that 'samples received in good order'. Samples were collected on 12 December 2023 but were not extracted for analysis until 18 December 2023. • Enviro lab Batch 340443, stated holding time exceedance for samples submitted for ASS screening. Stated that ice was present and that 'samples received in good order'. Samples were collected on 13 December 2024 but were not extracted for analysis until 15 December 2024. 2024. • Enviro lab Batch 34044A, stated: 'Chromium Suite: Samples were out of the recommended holding time for this analysis'. • Enviro lab Batch 340520, stated holding time exceedance for samples submitted for ASS screening. Stated that ice was present and that 'samples received in good order'. Samples were collected on 13 December 2024 but were not extracted for analysis until 19 December 2024.	The SRN advice suggests holding time breaches of the samples. Based on the review of the ASS data by PSK, if oxidation of the samples had occurred, appreciable TAA would have been observed in the samples from below the groundwater table. TAA was detected in a limited number of samples (56 out of 476 analysed), of which most were shallow samples from close to the water table where natural sulfide oxidation would be expected from exposure to atmospheric oxygen (approximately 6 samples in which TAA was detected were from deeper samples in which the presence of TAA would not have been expected). Ultimately, the low TAA concentrations in the subsoils indicate that significant oxidation did not take place once the samples were in transit and that the results can be used to inform the ASS EMP.

Relevant ASS Guideline Requirement	ASS Investigations Completed	Reviewer Comments
	Samples used in the KCL were collected in either December 2023 or January 2024 and were stored 'dried in a controlled environment' until May 2024 (and then composited). The report states that the soils experienced oxidation during storage. The report states '*The implication for the column test is that month 0 (M0) is not time=0 months for the start of oxidation'*.	The significant oxidation experienced by the samples in the first few months of the experiment impacts on the understanding of these soils with relation to this project. The initial months of oxidation of ASS are critical to understanding oxidation reactions, so by compromising this period, the reliability of the data is reduced, and conclusions can only be drawn at a high level to understand longer-term trends post M1.
Data Analysis		
Calculations for net acidity are to be undertaken as per Section 3 of the *National acid sulfate soils identification and laboratory methods manual* (Sullivan et al 2018b).	Geosyntec completed net acidity and liming rate calculations for the samples and tabulated these in Appendix G 'Table 1 – pH and CRS'.	PSK completed a check of the calculations for net acidity. The net acidity and liming rates calculations in Appendix G 'Table 1 – pH and CRS' were checked by converting the pdf of the ASS data tables into Excel and reperforming all calculations on the samples. It is noted that Geosyntec utilised a factor of safety (FOS) of 1.5 which is deemed appropriate for the assessment. Geosyntec also adopted an agricultural lime (Aglime) effective neutralising value of 95. Acid neutralising capacity (ANC) was not included in the Net Acidity calculations for the D1 and D2 layers but was included in the calculations for D3 given that the ANC was corroborated using the KCL testing results. The summary liming rate table in the draft report were checked. The Net Acidity (without ANC %S w/w) values were correct; however, the summary liming rates within the report were incorrect but were subsequently amended by Geosyntec in the final report.
Check of box plots	Charts include box plots were checked. Any inaccuracies were notes.	These were amended by Geosyntec in the final report.

4.0 SUMMARY OF KEY FINDINGS OF REVIEW

- While the investigation frequency was not in accordance with the NSW Acid Sulfate Soils Manual (ASSMAC 1998), there is sufficient ASS data from below the water table to enable characterisation of the geological/geomorphological units and development of an ASS EMP for the fines.
- The presence and extent of ASS in the unsaturated sand profile (i.e. sand located between 5m AHD and the groundwater table) was out of the scope of the Geosyntec investigation. The unsaturated soil profile will need to be investigated during early works and prior to the extraction of this material. The unsaturated sand is to be sampled in accordance with the *National ASS Sampling Guideline* (Sullivan et al. 2018a)
- Additional testing will need to be undertaken during early works on *in situ* ASS to assess the mobility of metals and metalloids in the dredged sediments under site-specific conditions and to better understand risks to the Site and receptors. This includes further analysis such as elutriate testing as per the *Guidelines for the dredging of acid sulfate soil sediments and associated dredge spoil management* (Simpson et al. 2018c) and the *National Assessment Guidelines for Dredging 2009*. The GWMP developed for the Site (ENV Solutions 2025) provides guidance relating to testing of fines to assess metal leachability.
- The testing regime (including the quality control program) adopted on the site was considered above that required by the *National ASS Sampling Guideline* (Sullivan et al. 2018a). Sample holding time breaches were noted; however, the low TAA concentrations in the subsoils indicate that significant oxidation did not take place when the samples were in transit, thus the results are considered acceptable for informing the ASS EMP.
- The samples used in the KCL experiments had undergone oxidation prior to the commencement of testing. As such, the reliability of the results, with respect to reaction kinetics, is considered reduced. However, the KCL experiments provide an understanding of metal leachability and inherent neutralisation capacity if the soils were to be oxidised for a minimum period of 21 weeks.
- This assessment included a review of the Geosyntec reports. Key findings and notable errors were summarised and provided to Geosyntec for finalisation of their report, but additional data inaccuracies may also be present in the Geosyntec final ASS Investigation report.

5.0 CONCLUSIONS

Based on the ASS investigations completed at the Site it is concluded that there was sufficient data to develop an ASS EMP for fines located below the water table.

6.0 STUDY LIMITATIONS

Your attention is drawn to the limitations of this report which are attached to this report. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be. The document is not intended to reduce the level of responsibility accepted by PSK, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

PSK ENVIRONMENTAL PTY LTD

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ATTACHMENTS

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