

9 September 2019

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Via email

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**Re: NSW Land and Environment Court (2018/342158) Menangle Quarry - flood mitigation**

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Dear Luke,

On 23 August 2019, we provided information on the proposed riverside batter angles in the Stage 8 extraction area for the proposed Menangle Sand and Soil Extension Project (my letter of 23 August 2019, *NSW Land and Environment Court (2018/342158) Menangle Quarry – Riverside Batter*). The letter proposed to limit the length of the riverside batter with a slope of 1:1 (vertical:horizontal<sup>1</sup>) to 30 m, and to apply a permanent riverside batter slope of 1:5 to mitigate the risk of scour during flooding.

This letter provides additional information on the proposed batter angles at the quarry and other measures to mitigate the risk of scour during flooding. The information that it presents supersedes the information in my letter of 23 August 2019.

An attached quarry schematic illustrates the batters discussed in this letter.

## 1 Batter angles

### 1.1 Riverside batter

The riverside batter will be between the horizontal setback area and the base of the pit.

It is proposed that:

- a short-term riverside batter with a maximum slope of 1:1, is used during sand and soil extraction – this will allow the efficient extraction of the resource;
- following extraction of material above this batter, the batter will be built up with suitable site material to give a permanent slope of 1:5 – this will provide additional assurance that the bank will be stable if the active extraction area is flooded during extraction;
- the maximum length of the riverside batter that has a slope between 1:1 and 1:5 will be restricted so that it can be covered with a 1:5 batter within 12 hours if flooding is predicted (see below);
- regardless of the amount of material required, the maximum length of the riverside batter that has a slope between 1:1 and 1:5 will be restricted to 30 m;

<sup>1</sup> All slopes in this letter are expressed as vertical:horizontal.

- in the final landform, the riverside batter will have a permanent slope of 1:5 – this will provide additional assurance that the back will be stable in the long term; and
- if over the life of the quarry, activities temporarily cease in the extraction area such that the excavator is relocated from the Stage 8 area, the riverside batter will be covered to form a 1:5 batter.

The horizontal setback area will be a mixture of graded and ungraded areas, of varying widths and of varying heights, so the width of the final 1:5 riverside batter will vary along the length extraction area. This will provide a varied, more natural looking final landform. The attached cross-sections and quarry schematic show the combined effect of Menangle Sand and Soils' proposal to retain all the trees in the horizontal setback area and to form the final riverside batter with a permanent slope of 1:5.

## 1.2 Advancing quarry face

The quarry will progressively advance upstream at an average rate of 150 m/year. The advancing quarry face will face downstream.

When the Nepean River floods, the river level will rise until, if the flood level is sufficient, flood water will overtop the graded horizontal setback area and flow into the extraction area or will overtop the river bank upstream of the extraction area and flow along the bank to enter the extraction over the advancing face. A maximum batter angle of 1:2 will be applied to the advancing face to minimise any scour occurring as the water initially flows down the batter, until the water level in the extraction area is at the same level as the river.

## 1.3 Trailing quarry face

The trailing quarry face, between the active extraction area and the infilled base of the completed pit, will face upstream.

A maximum landward batter angle of 1:5 is proposed for this face as it will face upstream in a flood. As for the riverside batter, this will mitigate the scour risk.

## 1.4 Landward batter

The landward batter is on the far side of the extraction area from the river.

A maximum landward batter angle of 1:1 is proposed as it will be exposed to far lower flood current speeds and peak shear stress than the riverside batter.

# 2 Flood mitigation

## 2.1 Controlling the length of 1:1 riverside batter

As stated above, the length of the riverside batter with a slope between 1:1 and 1:5 will be limited such that it can be built up to a 1:5 batter within 12 hours of predicted flooding. The Stage 8 area will be serviced by an excavator and a haul truck, there are also about four front-end loaders in the Stage 7 processing area that can be quickly moved to the Stage 8 area to move sand and soil. This equipment could build up a batter at a rate of at least 400 tonnes/hour. In 10 hours, at least 4,000 tonnes of material could be moved. The lengths of 1:1 riverside batter that could be covered in this period in two representative scenarios are presented in Table 2.1.

**Table 2.1 Riverside batter calculation**

Dimension	Units	Scenario	
		Adjacent to graded horizontal setback area	Adjacent to high bank formed by ungraded horizontal setback area
Level of pit base	mAHD	62	62
Level of top of riverside batter	mAHD	64	71
Height of riverside batter	m	2	9
Depth of 1:1 riverside batter	m	2	9
Cross-sectional area of 1:1 batter	m <sup>2</sup>	2	40.5
Depth of 1:5 batter	m	10	45
Cross-sectional area of 1:5 batter	m <sup>2</sup>	10	202.5
Maximum cross-sectional area to be filled	m <sup>2</sup>	8	162
Mass of material that can be moved in 10 hours	tonnes	4,000	4,000
Bulk density	tonnes/m <sup>3</sup>	2	2
Volume of material that can be moved in 10 hours	m <sup>3</sup>	2,000	2,000
Maximum length of 1:1 batter	m	250*	12

Notes: \* The maximum length of the riverside batter with a slope between 1:1 and 1:5 that is present at any time will be restricted to 30 m.

During extraction, there will be a range of riverside batter heights and batter angles so the length of the batters will vary within the rules that the riverside batter could be covered to a slope of 1:5 with no more than 4,000 tonnes of sand and soil within 10 hours and the length of slope between 1:1 and 1:5 is less than 30 m.

## 2.2 Flood warnings

The quarry has experienced a number of floods over the past 40 years of operations. Quarry personnel, six of whom have worked at the quarry for over 25 years, remain alert to the weather conditions that can cause the flooding in the Nepean River. This includes remaining vigilant when the quarry is closed as mobile plant may need to be moved to higher ground at night prior to flooding so that the plant is not inundated.

The Bureau of Meteorology provides flood warnings for the Nepean River. These warning are generally checked daily, and hourly during periods of heavy rain. The State Emergency Service also telephone the quarry when flooding is predicted.

Flood warnings based on weather predictions are generally provided two to three days before flooding occurs at Menangle. However, at times there has been only 12-hours notice, the time it takes for water released upstream to travel to Menangle.

## 2.3 Flood prediction actions

The following actions will be taken when flooding of the Nepean River above 64 m AHD in the Stage 8 area is predicted:

- any riverside batter that has a batter angle of less than 1:5 will be built up so that it has a maximum 1:5 slope;

- exposed batters and the base of the pit will be flattened so that there are no isolated highpoints susceptible to scour;
- all exposed sand and soil will be smoothed such that there are no rapid changes in slopes, particularly at the intersections of different batters; and
- unattended earthmoving equipment will not be left within the Stage 8 area while a flood warning is current.

These measures will be detailed in a flood preparedness plan that will be part of the site's operational environmental management plan.

### 3 Conclusion

We have valued the opportunity to discuss the proposal with DPIE and the experts that it has engaged. We believe that our responses to the matters raised have further improved the proposal and look forward to closing out these issues.

Yours sincerely



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## Legend

- ~64 mAHB Typical spot height
- Downhill slope (vertical:horizontal)
- Batter
- Pit
- Lower riverbank
- Ungraded
- Graded





