

16 September 2022

Mitchell McCormac
Terara Shoalhaven Sand
By email

Dear Mitchell,

RE: SUPPLEMENTARY WATER QUALITY MODELLING IN RESPONSE TO SHOALHAVEN CITY COUNCIL REQUEST FOR FURTHER INFORMATION – PROPOSED EXPANSION OF SAND EXTRACTION AT PIG ISLAND, TERARA, NSW

1 Introduction

Martens and Associates (**MA**) have prepared this response on behalf of Terara Shoalhaven Sand (the **Proponent**) to address comment 6a of the Request for Further Information (**RFI**) from Shoalhaven City Council (**Council**, dated 19 April 2022, REF: RA21/1000) in relation to a proposed expansion of sand extraction at Pig Island, Terara, NSW (the **Site**). Comment 6a is copied from a RFI from NSW Environmental Protection Authority (**EPA**, dated 4 November 2021, REF: DOC21/860087-34), and recommends:

The Estuarine Water Quality Impact Statement be revised to consider the implications of both the discovery of lenses and potential paucity in data on the existing modelling assumptions. The proponent is required to demonstrate whether the modelling remains accurate and representative on the basis of the discovery, with consideration given to the requirement for revision of modelling parameters within the current model.

In response to this request, MA have undertaken the following:

1. A literature review in respect of potential concentrations for water quality indicators. This aimed to reveal the likely range of concentrations that may be encountered beyond those already assumed for modelling.
2. Undertake supplementary TUFLOW Advection Dispersion (**TAD**) model relied upon as part of the project *Estuarine Water Quality Impact Assessment* report (MA, March 2019, the **MA 2019 report**) to include further sensitivity analysis based on the literature review.
3. Prepare updated water quality indicator impact maps and provide commentary.

2 Available Literature

As part of its investigation into a new parallel runway for Brisbane Airport, the Brisbane Airport Corporation Pty Ltd undertook an investigation into the chemistry of sediment pore water within Moreton Bay in areas where potential dredging would occur so that the impact of pore water release into the estuary could be modelled.¹ Sediment deposits at these sites were predominantly sand, silt and clay dominated pro-delta deposits,² with median fines (< 75 µm) content being 2%, this being similar to the present study area, although lenses with higher fines content did occur.

Results of the Runway EIS pore water sampling are summarised in Table 1.³ The following is observed:

- Median nutrient concentrations were lower than those adopted for this study.
- Some variation in pore water nutrient was observed, although the data spread appears to be wider in the case of TP.

Table 1: Statistical summary of pore water quality data.

Statistic	TN (mg/L)	TP (mg/L)
Minimum	2.20	0.09
10 th Percentile	2.38	0.10
25 th Percentile	2.85	0.13
Median	3.40	0.19
Mean	4.91	0.62
75 th Percentile	5.05	0.45
90 th Percentile	8.98	1.55
Maximum	13.00	2.88

In respect of TSS concentrations, the Runway EIS did not provide any estimates for suspended sediment release at the point of extraction, assuming that this would be negligible and could be ignored due to the dredging process being driven by suction rather than physical bed disturbance. This is consistent with our historical observations at the active dredge which did not reveal any noticeable sediment release at the dredge site.

3 Adopted Parameters for Sensitivity Analysis

On the basis of our literature review, the 90th percentile pore water data derived from the Runway EIS were considered suitable for assessing the maximum risk of potentially encountering higher fines content lenses during the extraction activities. In terms of TSS, the approach taken for

¹ Brisbane Airport Corporation Pty Ltd (2007) New Parallel Runway Draft EIS/MDP – Middle Banks, Moreton Bay, QLD, Chapter C2 Geology, Soils and Groundwater (**Runway EIS**).

² Runway EIS Section 2.2.

³ Refer to Runway EIS Section 2.2.6.

determining parameters for sensitivity modelling was to conservatively double the concentration adopted for the MA 2019 report, and then double the resultant concentration again to provide an upper bound. Adopted contaminant concentrations are provided in Table 2.

Table 2: Water quality indicator concentrations for sensitivity analysis.

Parameter	Scenario 1 ^A	Scenario 2	Scenario 3
TN (mg/L)	5.0	7.5	9.0
TP (mg/L)	0.2	0.5	1.6
TSS (mg/L)	55	100	200

Notes

A. Scenario 1 concentrations represent values used in the MA 2019 report.

4 TUFLOW Advection Dispersion Modelling

The only change to the TAD model was to the water quality indicator concentrations, which were adopted as shown in Table 2. All other model construction elements remained consistent with the MA 2019 model.

Water quality modelling results are provided in Attachment A, with drawing references summarised in Table 3. Results have been expressed in terms of maximum percent increase over the assumed background concentration occurring as a result of the proposed development.

Table 3: Water quality maximum concentration increase map references in Attachment A.

Parameter	Scenario 1	Scenario 2	Scenario 3
TN	Map 01	Map 02	Map 03
TP	Map 04	Map 05	Map 06
TSS	Map 07	Map 08	Map 09

5 Observations and Comments

The following observations are made in respect of the supplementary water quality TAD modelling:

1. Significant changes in water chemistry are not expected, even under the higher concentrations assumed as part of the sensitivity analysis.
2. Maximum increases over background concentrations are typically < 0.2 %. These are negligible and well within the natural variability of the daily concentrations in the Shoalhaven River.
3. Whilst it is possible that higher fines content lenses may be encountered during the dredging operations, these would be temporary and based on the modelling, are not expected to lead to any adverse water quality outcomes.
4. Based on the modelling completed, no cumulative effect on estuary health is therefore anticipated.

6 Summary

In response to concerns raised by the EPA in respect of potential discovery of lenses and paucity of data, we have further considered a range of potentially higher pollutant concentrations based on available literature. These higher pollutant concentrations were applied to the water quality modelling for a range of sensitivity analysis scenarios to investigate potential impacts on the receiving environment. Findings were:

1. Significant changes in water chemistry are not expected, even under the higher concentrations assumed as part of the sensitivity analysis, with maximum increases over background concentrations are typically < 0.2 %. These are negligible and well within the natural variability of the daily concentrations in the Shoalhaven River.
2. Whilst it is possible that higher fines content lenses may be encountered during the dredging operations, these in our view would be temporary and based on the modelling, are not expected to lead to any adverse immediate or long-term water quality outcomes.

If you require any further information, please do not hesitate to contact our offices.

For and on behalf of

Martens & Associates Pty Ltd

A handwritten signature in blue ink, appearing to read 'D. Martens'.

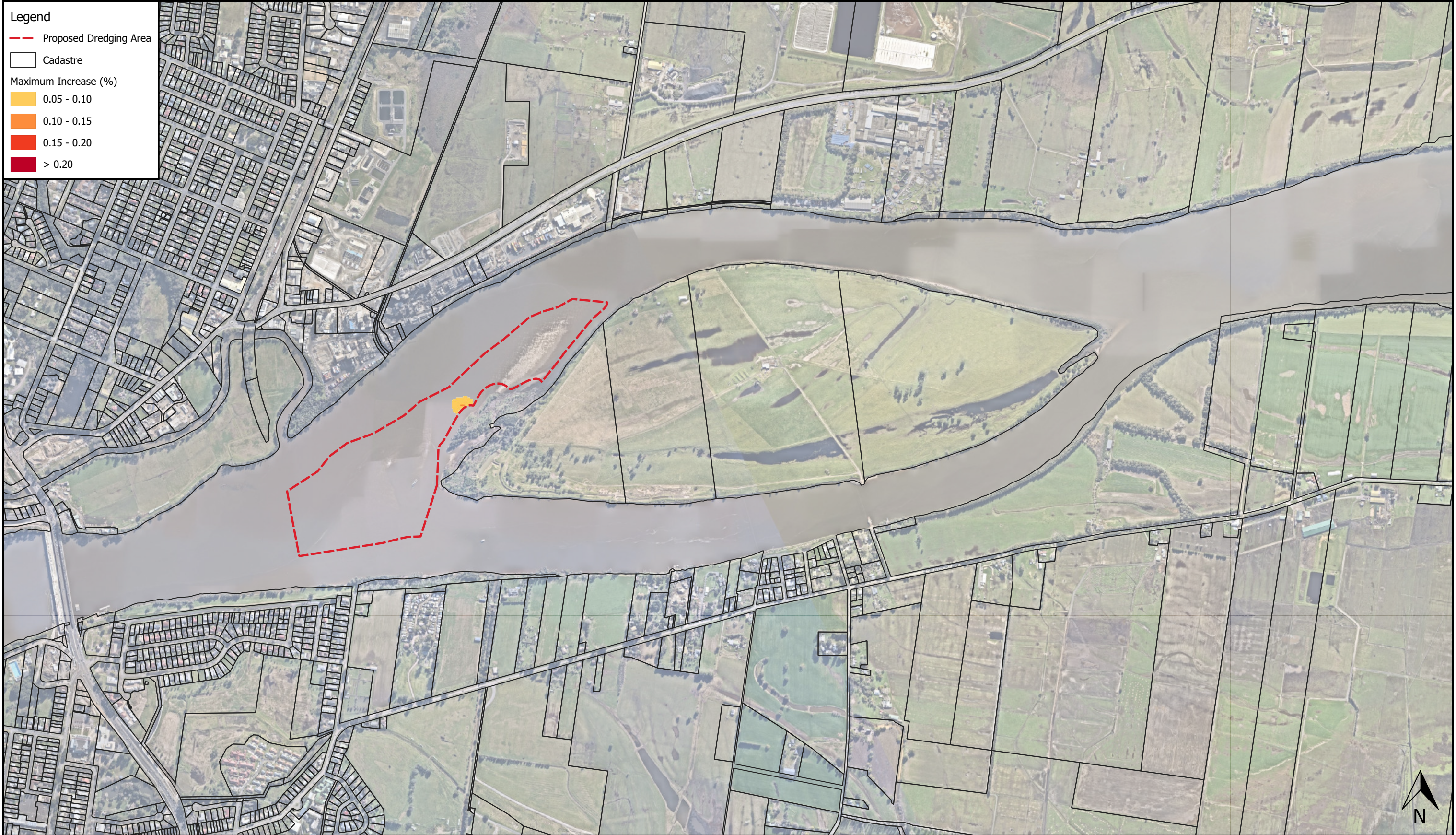
Dr Daniel Martens

LLB(Hons1), BSc(Hons1), MEngSc, PhD, FIEAust, CPEng, NER, RPEQ, APEC Eng, IntPE(Aus)

Director, Principal Engineer



7 Attachment A: Water Quality Impact Maps



0 100 200 300 400 500 m

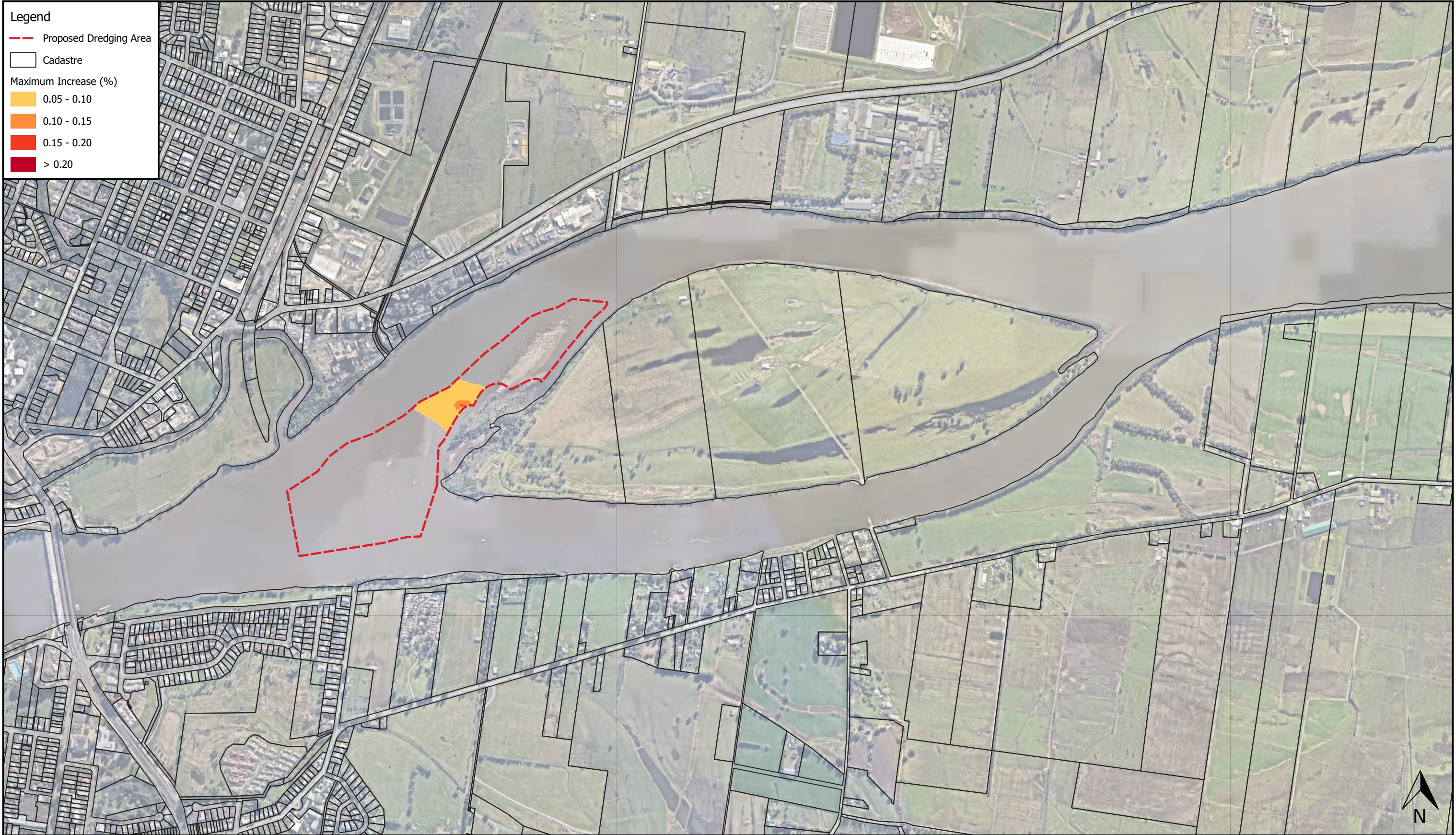
1:12500 @ A3

Viewport A

Notes:
- Aerial from Nearmaps (2022).
- Cadastre from NSW Spatial Services (2020) 'Clip & Ship' SIX Maps website.

Map Title / Figure:
Total Nitrogen Maximum Increase (%)
Scenario 1 - TN = 5.0 mg/L

Map 01	Map
Pig Island, Terara, NSW	Site
Expansion of Sand Extraction	Project
Water Quality Assessment	Sub-Project
Terara Shoalhaven Sand	Client
14/09/2022	Date



0 100 200 300 400 500 m

1:12500 @ A3

Viewport A

Notes:

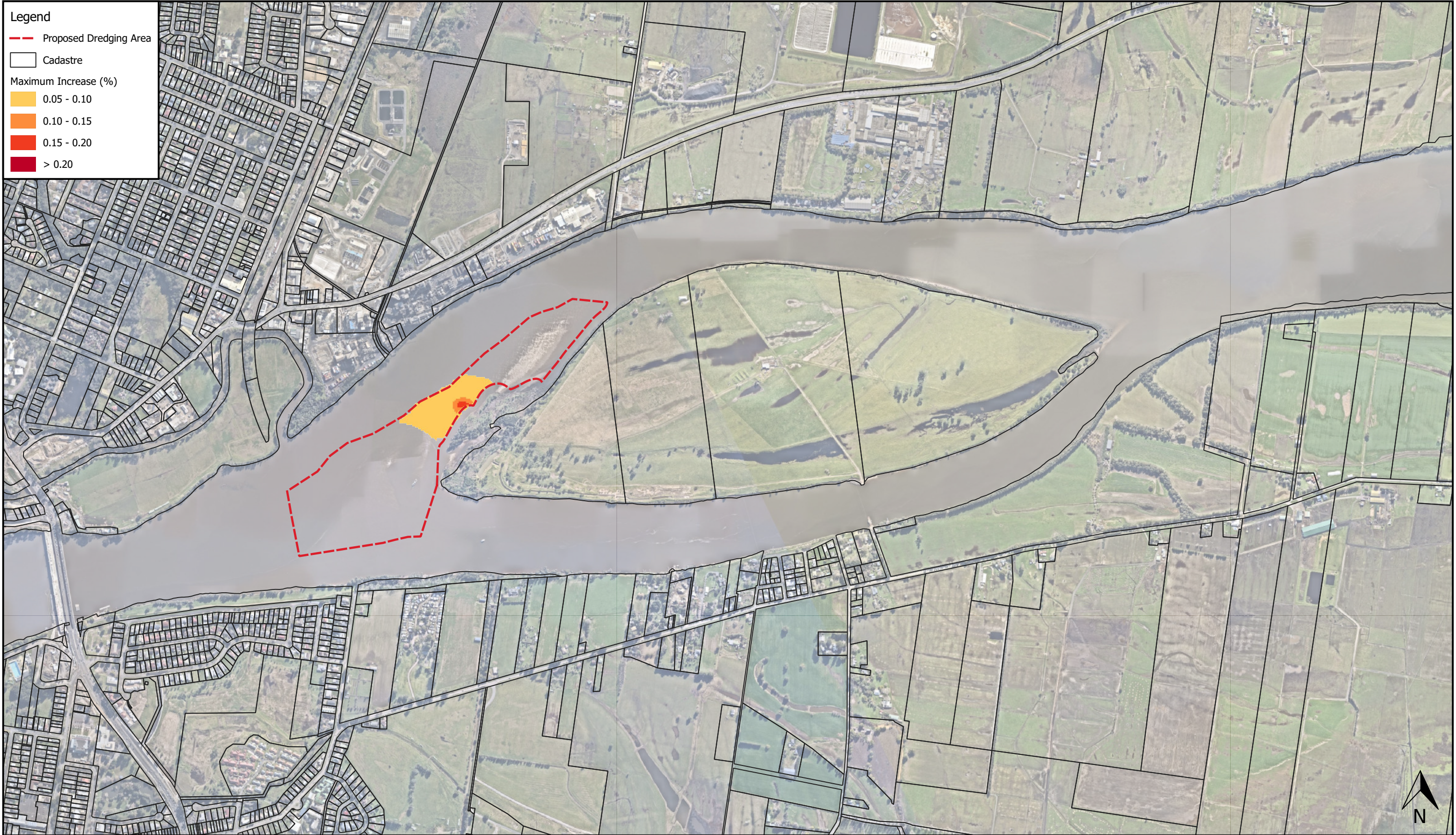
- Aerial from Nearmaps (2022).

- Cadastre from NSW Spatial Services (2020) 'Clip & Ship' SIX Maps website.

Total Nitrogen Maximum Increase (%)
Scenario 2 - TN = 7.5 mg/L

Map 02
Pig Island, Terara, NSW
Expansion of Sand Extraction
Water Quality Assessment
Terara Shoalhaven Sand
14/09/2022

Map
Site
Project
Sub-Project
Client
Date





0 100 200 300 400 500 m

1:12500 @ A3

Viewport A

Notes:
- Aerial from Nearmaps (2022).
- Cadastre from NSW Spatial Services (2020) 'Clip & Ship' SIX Maps website.

Map Title / Figure:
Total Phosphorous Maximum Increase (%)
Scenario 1 - TP = 0.2 mg/L

Map 04	Map
Pig Island, Terara, NSW	Site
Expansion of Sand Extraction	Project
Water Quality Assessment	Sub-Project
Terara Shoalhaven Sand	Client
14/09/2022	Date



Legend

--- Proposed Dredging Area

□ Cadastre

Maximum Increase (%)

- 0.05 - 0.10
- 0.10 - 0.15
- 0.15 - 0.20
- > 0.20

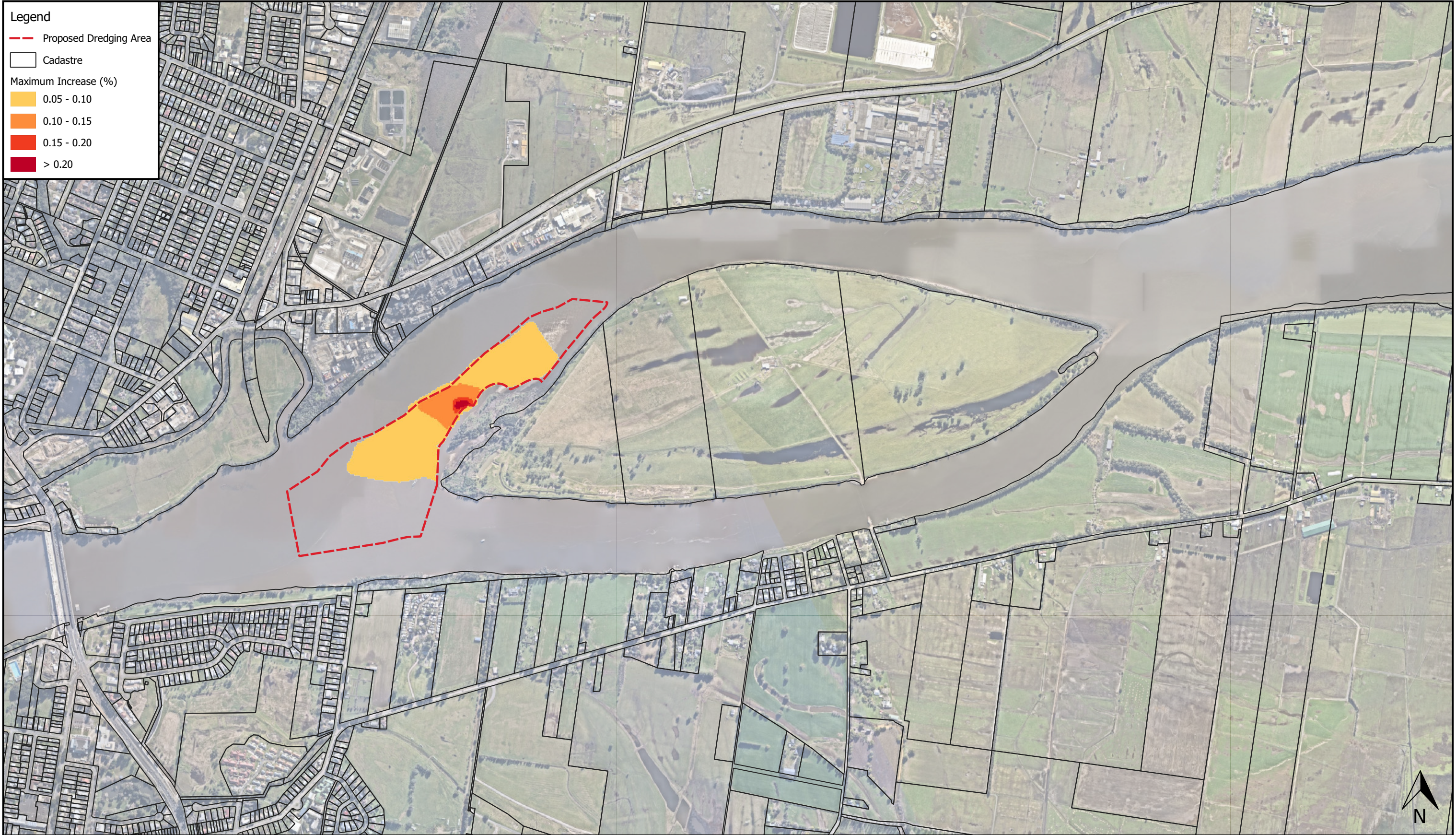
0 100 200 300 400 500 m

1:12500 @ A3
Viewport A

Notes:
- Aerial from Nearmaps (2022).
- Cadastre from NSW Spatial Services (2020) 'Clip & Ship' SIX Maps website.

Map Title / Figure:
Total Phosphorous Maximum Increase (%)
Scenario 2 - TP = 0.5 mg/L

Map 05	Map
Pig Island, Terara, NSW	Site
Expansion of Sand Extraction	Project
Water Quality Assessment	Sub-Project
Terara Shoalhaven Sand	Client
14/09/2022	Date



0 100 200 300 400 500 m

1:12500 @ A3

Viewport A

Notes:

- Aerial from Nearmaps (2022).

- Cadastre from NSW Spatial Services (2020) 'Clip & Ship' SIX Maps website.

Total Phosphorous Maximum Increase (%)
Scenario 3 - TP = 1.6 mg/L

Map 06
Pig Island, Terara, NSW
Expansion of Sand Extraction
Water Quality Assessment
Terara Shoalhaven Sand
14/09/2022

Map
Site
Project
Sub-Project
Client
Date

Map Title / Figure:



0 100 200 300 400 500 m

1:12500 @ A3

Viewport A

Notes:

- Aerial from Nearmaps (2022).

- Cadastre from NSW Spatial Services (2020) 'Clip & Ship' SIX Maps website.

Map Title / Figure:
Total Suspended Solids Maximum Increase (%)
Scenario 1 - TSS = 55 mg/L

Map 07
Pig Island, Terara, NSW
Expansion of Sand Extraction
Water Quality Assessment
Terara Shoalhaven Sand
14/09/2022

Map
Site
Project
Sub-Project
Client
Date



0 100 200 300 400 500 m

1:12500 @ A3

Viewport A

Notes:

- Aerial from Nearmaps (2022).

- Cadastre from NSW Spatial Services (2020) 'Clip & Ship' SIX Maps website.

Map Title / Figure:
Total Suspended Solids Maximum Increase (%)
Scenario 2 - TSS = 100 mg/L

Map 08
Pig Island, Terara, NSW
Expansion of Sand Extraction
Water Quality Assessment
Terara Shoalhaven Sand
14/09/2022

Map
Site
Project
Sub-Project
Client
Date

