TWEED SAND BYPASSING

Maintenance Dredging Program

29th NSW Coastal Conference

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Linda Rijkenberg, Alex Atkinson – Queensland Government Hydraulics Laboratory, Qld Department of Environment and Science

TWEEDSAND BYPASSING

- TSB entrance management & Dredge Management Plan
- Recap of 2019-2021 dredging campaigns
- Entrance Infill Rates
- Post-2021 dredge entrance evolution
- Post-flood entrance morphology
- 2022 dredge planning

TWEED SAND BYPASSING

TSB entrance management & Dredge Management Plan

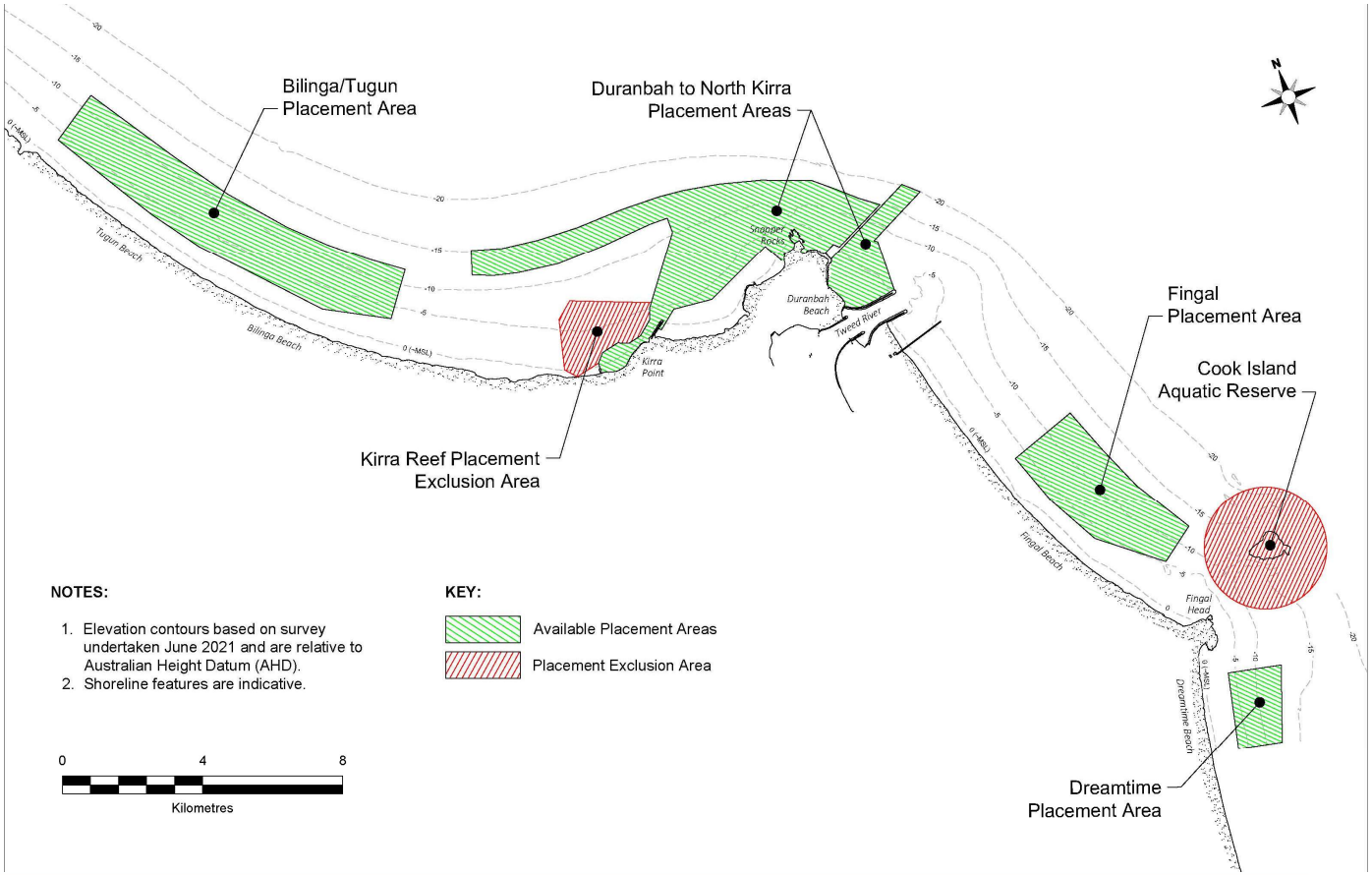
Tweed Sand Bypassing (TSB)

- TSB is a joint coastal management initiative of the New South Wales and Queensland State Governments.
- The objectives of the Project are to:
  1. Establish and maintain a safe, navigable entrance to the Tweed River, and
  2. Restore and maintain the coastal sand drift to the southern Gold Coast beaches.
- These objectives are set out in both the NSW and Qld legislation, and are achieved in perpetuity through the use of permanent sand bypassing jetty and regular dredging.
- Tweed River Entrance Sand Bypassing Company (TRESBCo -a subsidiary of McConnell Dowell Constructions) is responsible for the operation and maintenance of the sand bypassing system as detailed in the Concession Agreement (CA) made in 1999

Entrance Management – pre 2019

- Since TSB's commencement only minor changes to approved placement areas had been implemented
- There were limited opportunities for proactive dredging through the existing contractual arrangement
- Approval for additional placement areas had been obtained over time although not utilised
- It was identified that there was a need for operational flexibility to continue to meet project objectives and stakeholder expectations
  - An extensive process to amend the Concession Agreement was pursued and ultimately achieved
  - Approval and utilisation of additional placement areas undertaken

TWEEDSAND BYPASSING

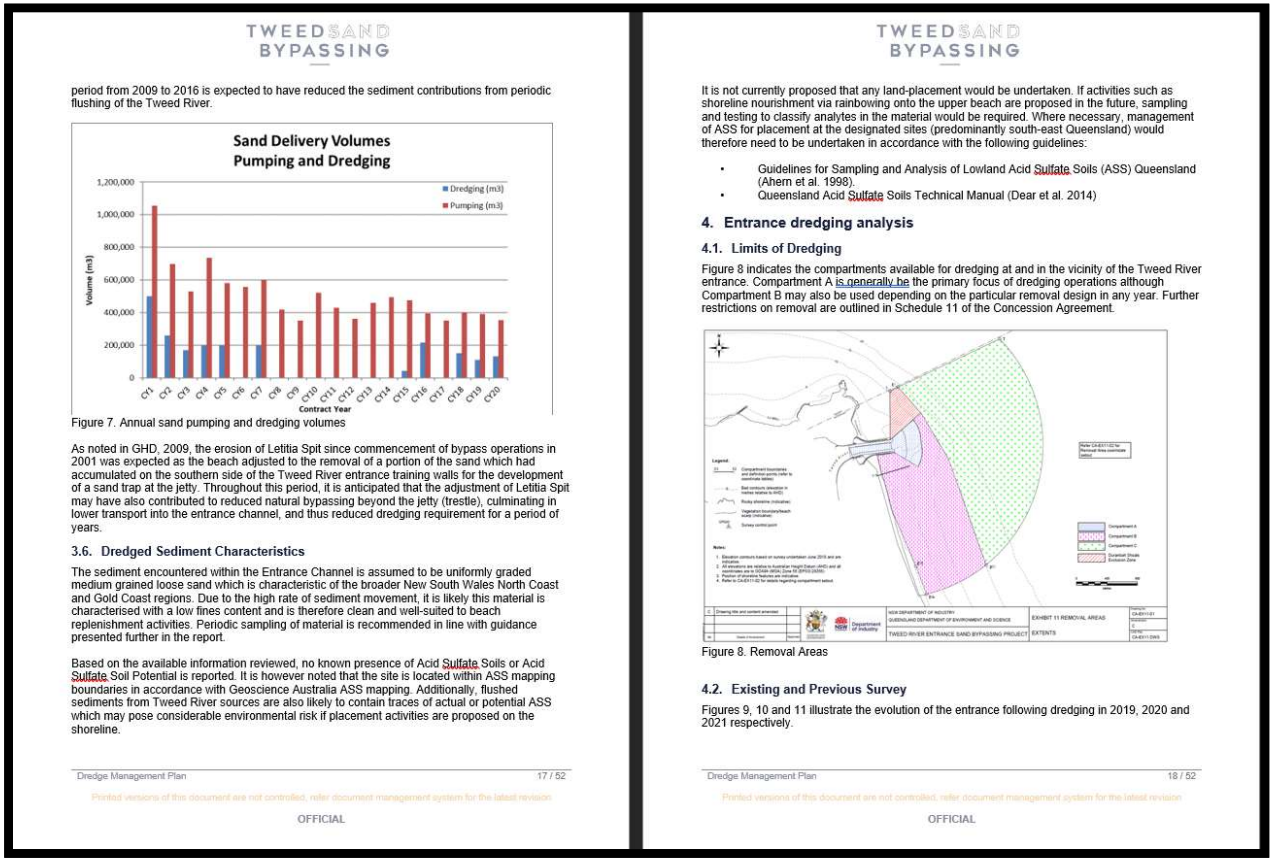


Dredge Management Plan

An effort to undertake annual maintenance dredging would allow for optimal sand delivery, better financial forecasting and management of legislated objectives.

The Dredge Management Plan guides this annual program:

- List of approvals
- Review of environmental data
- Entrance volume analysis
- Dredge cut design
- Placement area distribution and design
- Operations
  - Dredge vessel
  - Dredge methodology
  - Placement methodology
  - Monitoring and sampling
- Community consultation



period from 2009 to 2016 is expected to have reduced the sediment contributions from periodic flushing of the Tweed River.

Figure 7. Annual sand pumping and dredging volumes

As noted in GHD, 2009, the erosion of Letitia Spit since commencement of bypass operations in 2001 was expected as the beach adjusted to the removal of a portion of the sand which had accumulated on the southern side of the Tweed River entrance training walls for the development of a sand trap at the jetty. Throughout this period, it is anticipated that the adjustment of Letitia Spit may have also contributed to reduced natural bypassing beyond the jetty (trestle), culminating in lower transport into the entrance channel, and thus reduced dredging requirement for a period of years.

3.6. Dredged Sediment Characteristics

The sediment encountered within the Entrance Channel is assumed to be uniformly graded medium grained loose sand which is characteristic of the broader New South Wales North Coast and Gold Coast regions. Due to the high rate of sediment movement, it is likely this material is characterised with a low fines content and is therefore clean and well-suited to beach replenishment activities. Periodic sampling of material is recommended in line with guidance presented further in the report.

Based on the available information reviewed, no known presence of Acid Sulfate Soils or Acid Sulfate Soil Potential is reported. It is however noted that the site is located within ASS mapping boundaries in accordance with Geoscience Australia ASS mapping. Additionally, flushed sediments from Tweed River sources are also likely to contain traces of actual or potential ASS which may pose considerable environmental risk if placement activities are proposed on the shoreline.

It is not currently proposed that any land-placement would be undertaken. If activities such as shoreline nourishment via rainbowing onto the upper beach are proposed in the future, sampling and testing to classify analytes in the material would be required. Where necessary, management of ASS for placement at the designated sites (predominantly south-east Queensland) would therefore need to be undertaken in accordance with the following guidelines:

- Guidelines for Sampling and Analysis of Lowland Acid Sulfate Soils (ASS) Queensland (Ahern et al. 1998).
- Queensland Acid Sulfate Soils Technical Manual (Dear et al. 2014)

4. Entrance dredging analysis

4.1. Limits of Dredging

Figure 8 indicates the compartments available for dredging at and in the vicinity of the Tweed River entrance. Compartment A is generally be the primary focus of dredging operations although Compartment B may also be used depending on the particular removal design in any year. Further restrictions on removal are outlined in Schedule 11 of the Concession Agreement.

Figure 8. Removal Areas

4.2. Existing and Previous Survey

Figures 9, 10 and 11 illustrate the evolution of the entrance following dredging in 2019, 2020 and 2021 respectively.

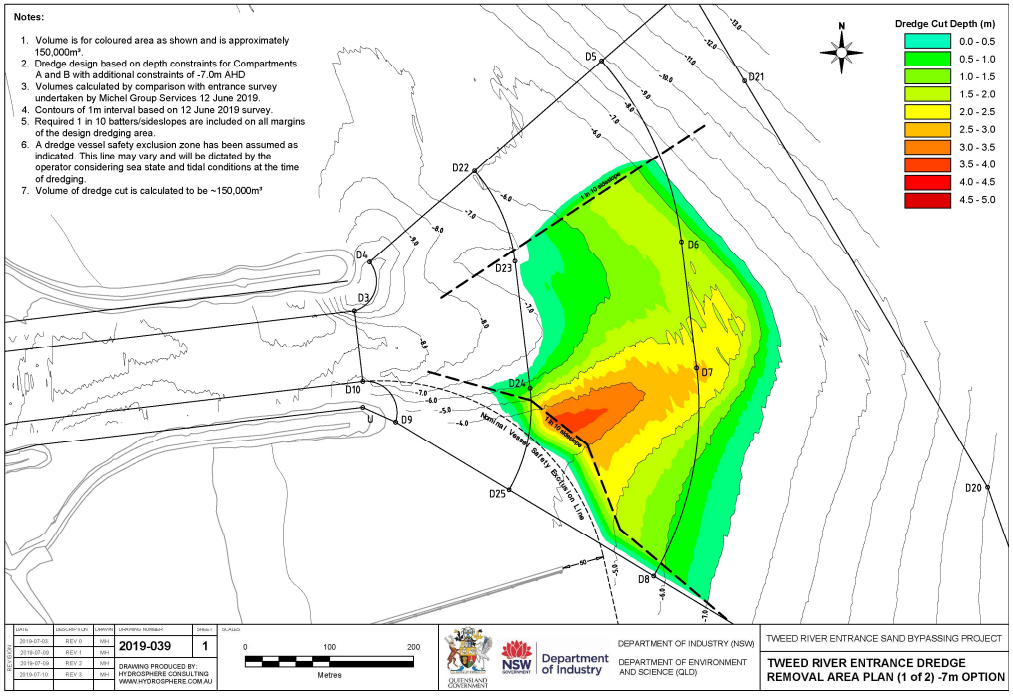
TWEED SAND BYPASSING

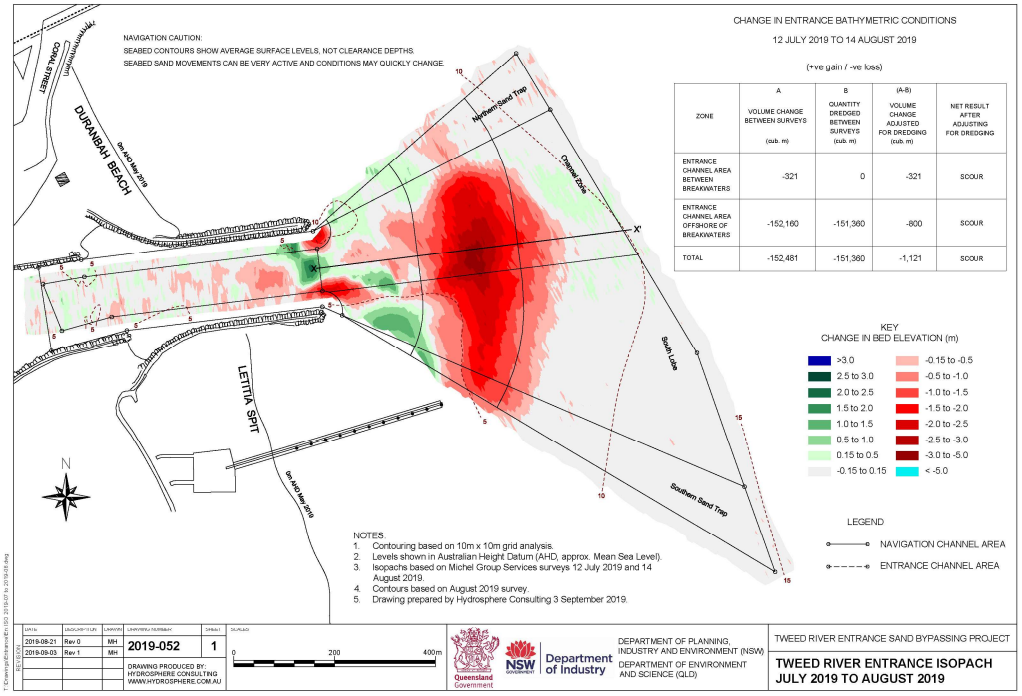
Recap of 2019-2021 dredging campaigns

TWEEDSAND BYPASSING

Dredging 2019 – 150,000m³

Actual – 151,360m³

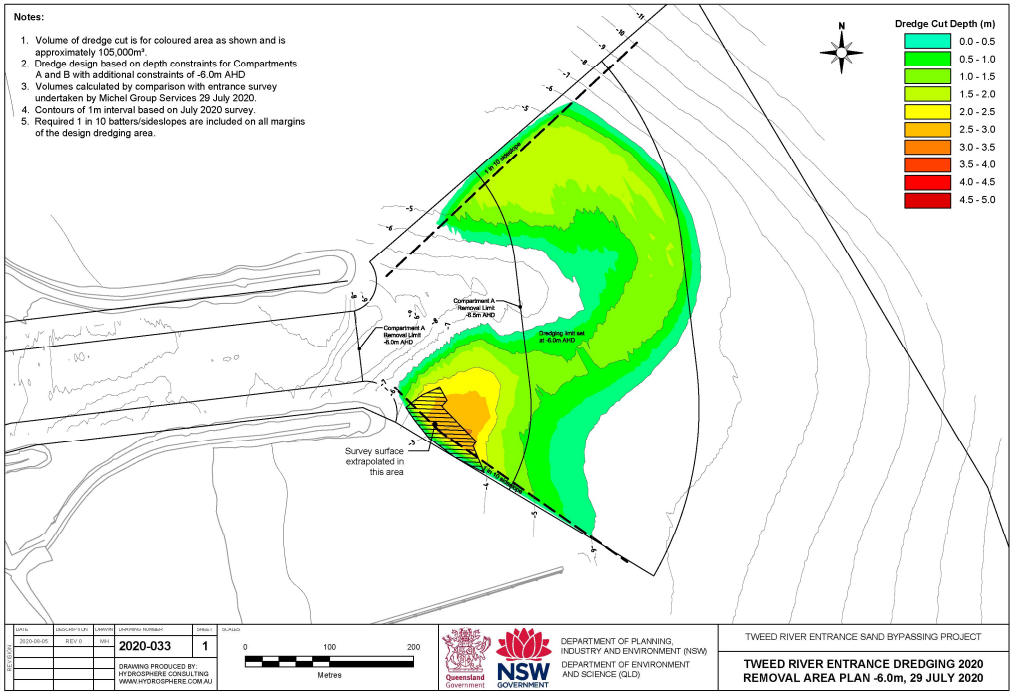


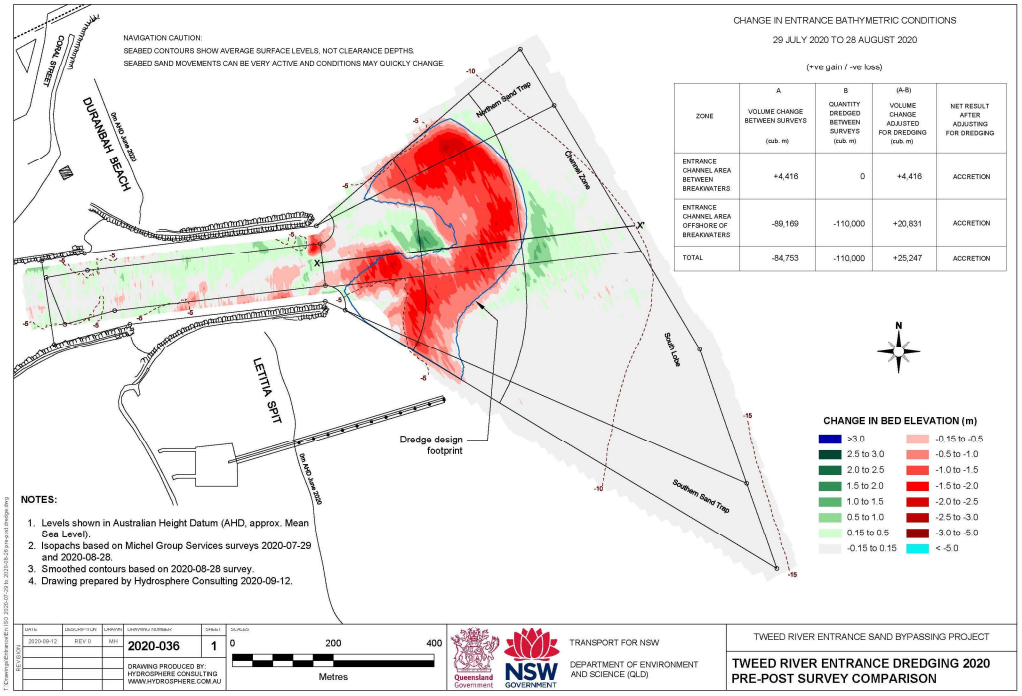


TWEEDSAND BYPASSING

Dredging 2020 – 105,000m³

Actual – 110,178m³

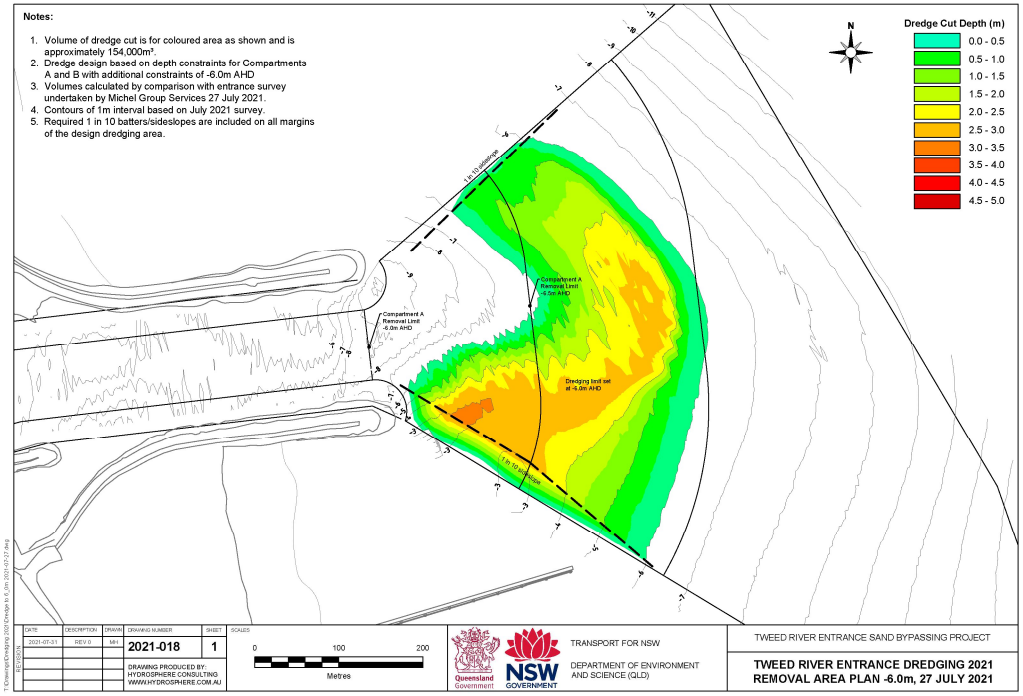


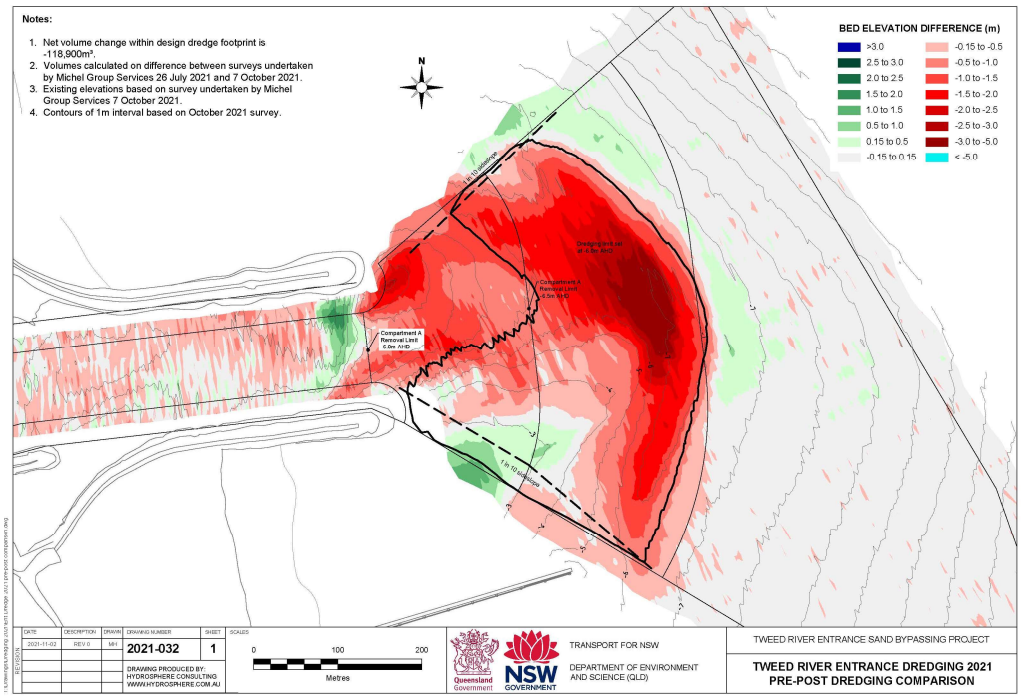


TWEEDSAND BYPASSING

Dredging 2021 – 154,000m³

Actual – 133,316m³





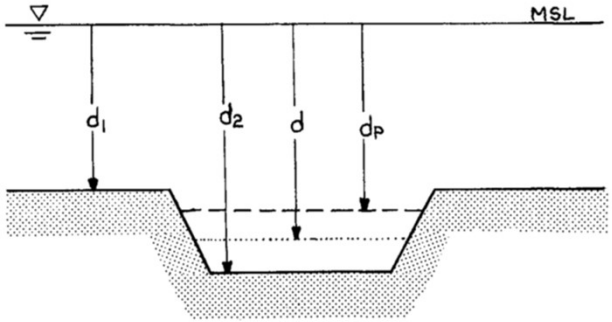
TWEED SAND BYPASSING

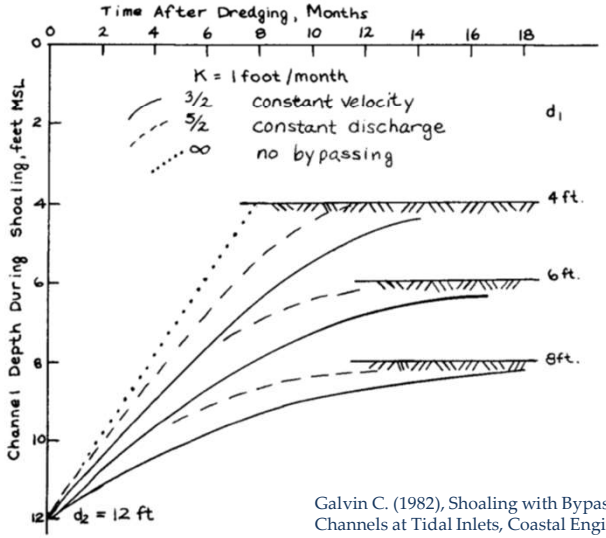
Entrance infill rates

Post-dredge analysis and guidance for future dredge design

Channel trapping efficiency

- KBR assisted in the development of TRESBCo's initial Dredge Management Plan, this estimated the trapping efficiency of dredge channels using Galvin's Method (Galvin, 1982)
- This method calculates shoaling rates within a channel based on characteristic wave heights and basic channel geometry
- Optimisation of channel width and dredge design depth based on typical sand bypass rates

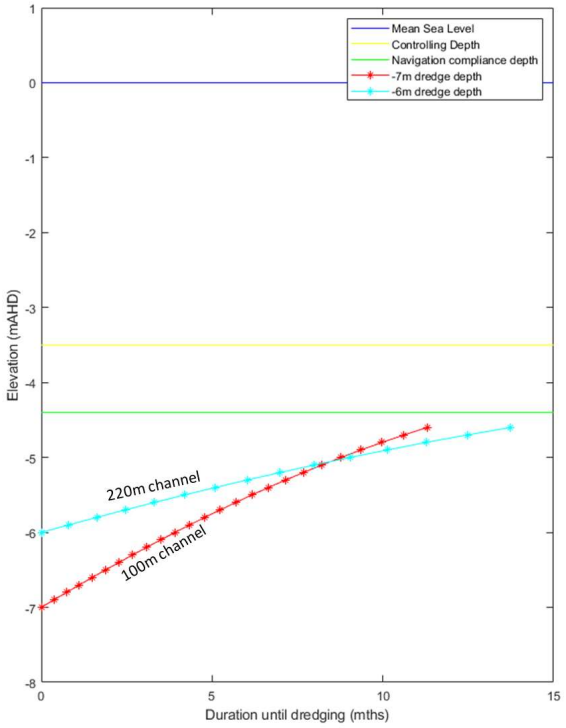


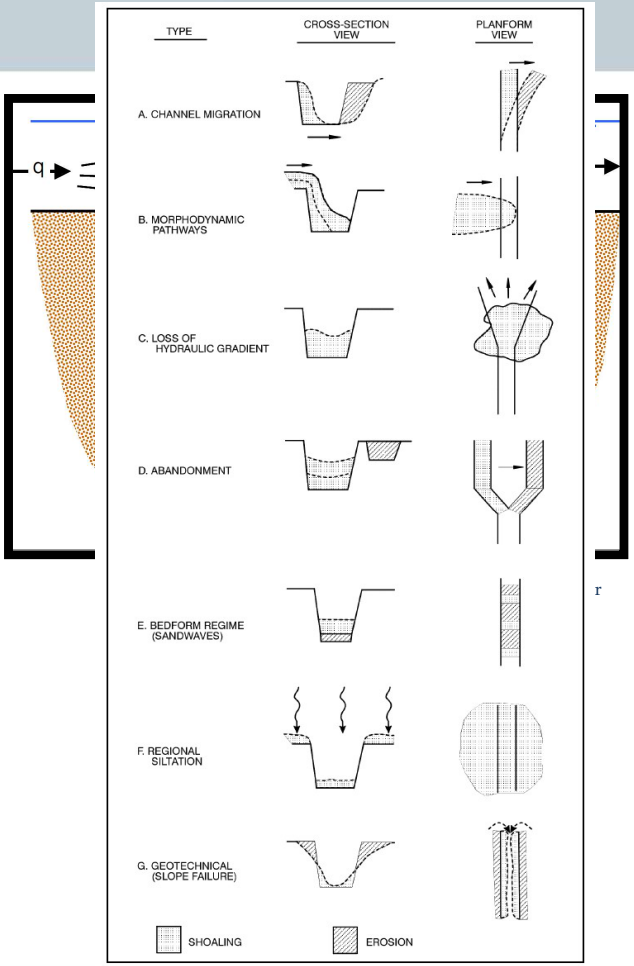


Galvin C. (1982), Shoaling with Bypassing for Channels at Tidal Inlets, Coastal Engineering 1982

Channel trapping efficiency

- Comparison of two idealised scenarios show the relationship between dredge depth and rate of infill. Depending on the compliance period required the dredge design can be adjusted accordingly
- Rosati & Kraus (2009) presents an analytical method for channel shoaling accounting for both channel infilling and bank encroachment
- Pope (2000) outlines the conceptual mechanisms which contribute to channel shoaling. For the Tweed River entrance, analysis of regular hydrographic survey data indicates that morphodynamic pathways and channel migration are significant

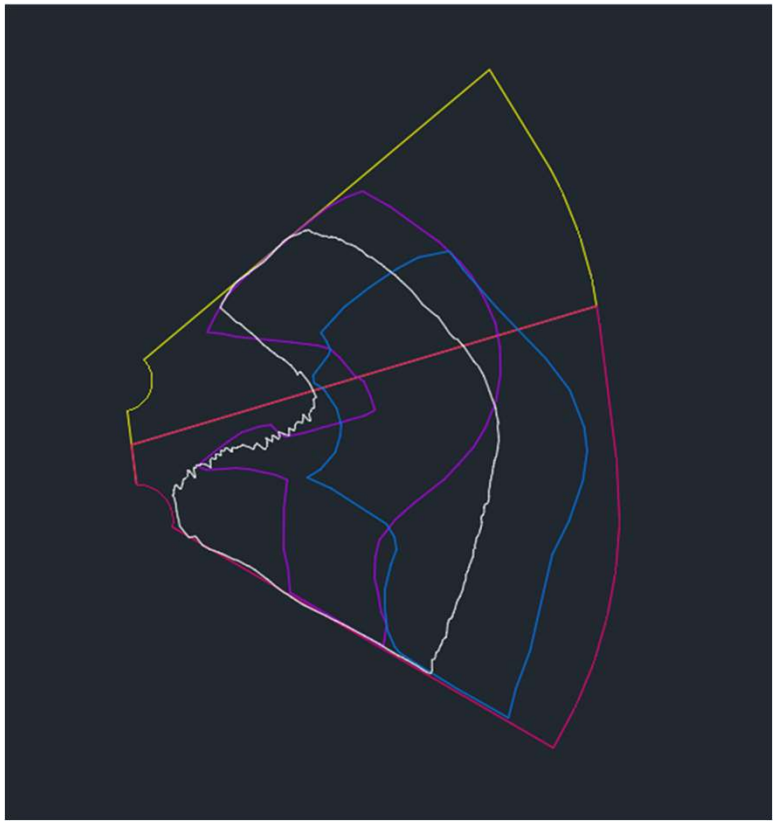




Pope, J. (2000). Where and Why Inlet Channels Shoal: A Conceptual Geomorphic Framework. CHETN-IV-12, USACE

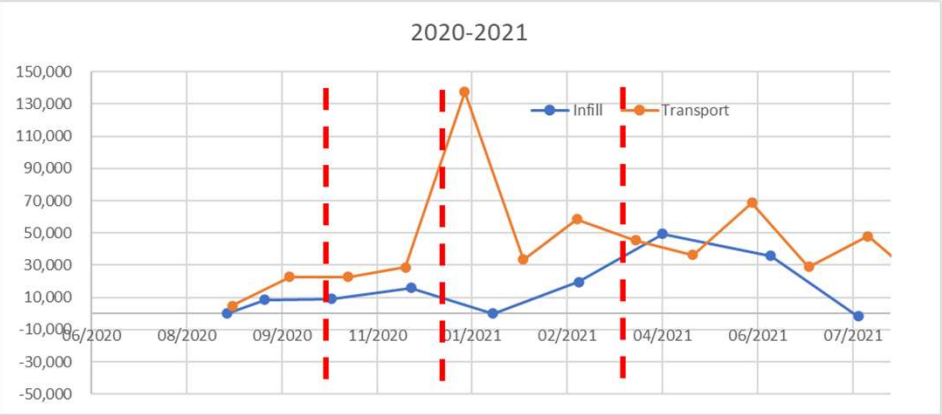
Infill rate calculation

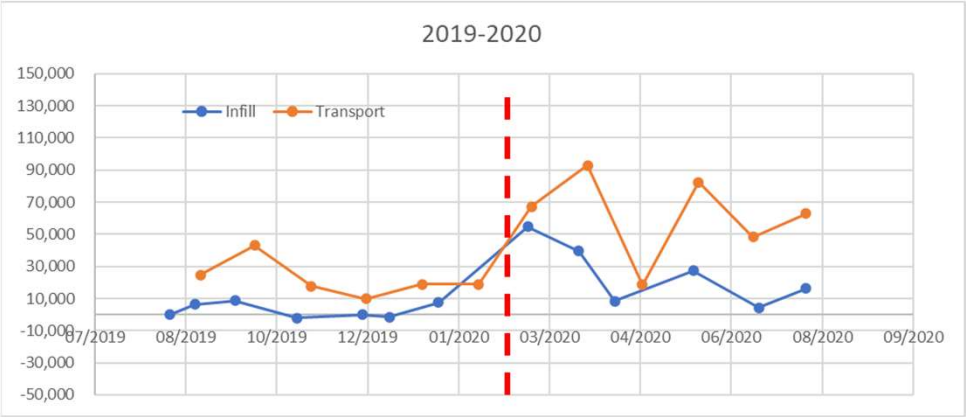
- The change in volume within prescribed entrance area compartments between each hydrographic survey has been used to determine infill rates
- The “North” and “South” entrance compartments are split by the typical navigation channel alignment
- The volume within each annual dredge cut area is also tracked
- Estimated longshore sediment transport rates are compared with infill rates to account for variable conditions year to year



Infill rate calculation

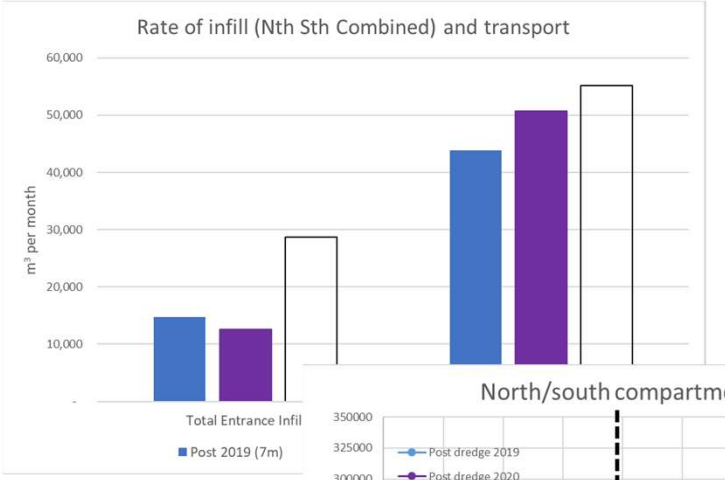
- Monthly transport estimates compared to infill rates generally trend well together (noting they are not calculated at a fixed interval)
- Some instances of high transport do not result in similar infill, indicating significant natural bypassing under these conditions

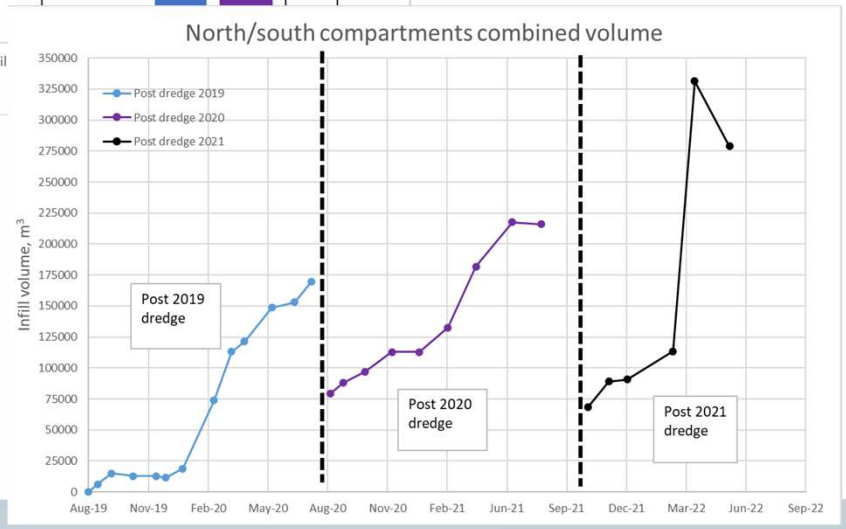




Infill rates per dredge campaign

- The dredge depth in 2019 was -7mAHD, infill rates following were on average 15,000m^3 / mth and transport 43,000m^3 / mth
- Contrast to post 2020 which was -6mAHD dredge depth and had infill rates of 12,000m^3 / mth and transport of 50,000m^3 / mth
- Although only one point of comparison so far, the resulting infill rates matched theoretical impact of dredging shallower
- Post 2021 infill rates were also within the expected range until Jan 2022





TWEED SAND BYPASSING

Post-2021 dredge entrance evolution

TWEEDSAND BYPASSING

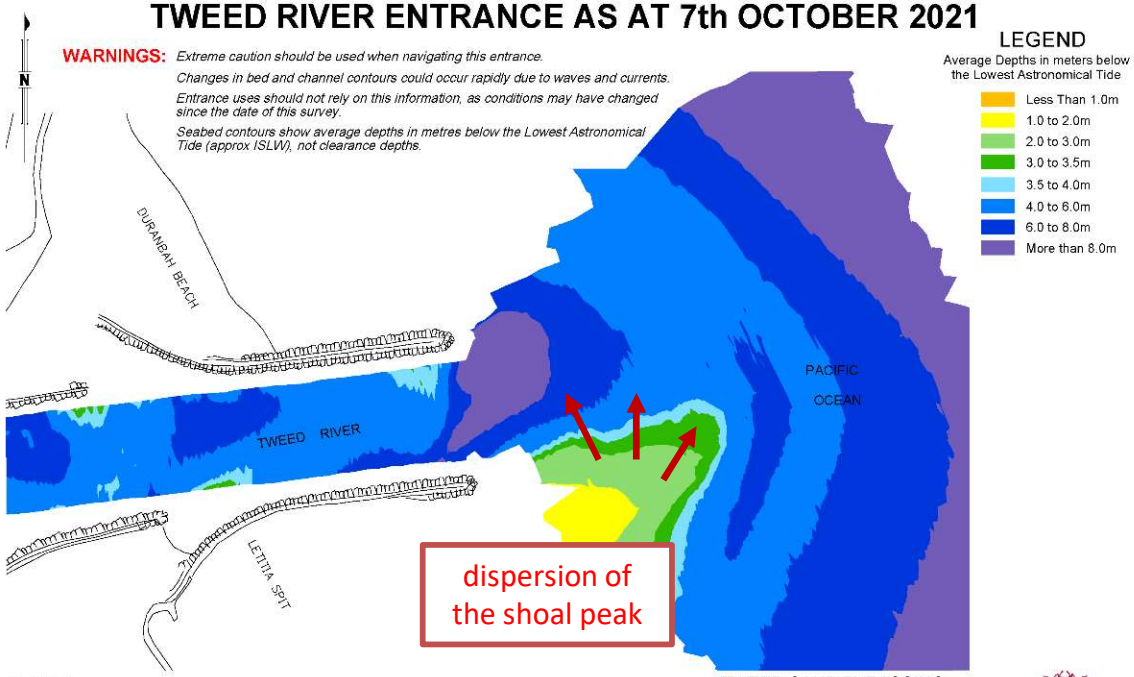
TWEED RIVER ENTRANCE AS AT 7th OCTOBER 2021

WARNINGS: *Extreme caution should be used when navigating this entrance.*

Changes in bed and channel contours could occur rapidly due to waves and currents.

Entrance uses should not rely on this information, as conditions may have changed since the date of this survey.

Seabed contours show average depths in metres below the Lowest Astronomical Tide (approx ISLW), not clearance depths.



LEGEND

Average Depths in meters below the Lowest Astronomical Tide

- Less Than 1.0m
- 1.0 to 2.0m
- 2.0 to 3.0m
- 3.0 to 3.5m
- 3.5 to 4.0m
- 4.0 to 6.0m
- 6.0 to 8.0m
- More than 8.0m

NOTES:

1. Survey information collected by Michel Group Services on 6th & 7th OCTOBER 2021.
2. This plan prepared by Michel Group Services on 15th OCTOBER 2021.
3. Surveys are undertaken for Tweed Sand Bypassing every three months to monitor entrance seabed levels.

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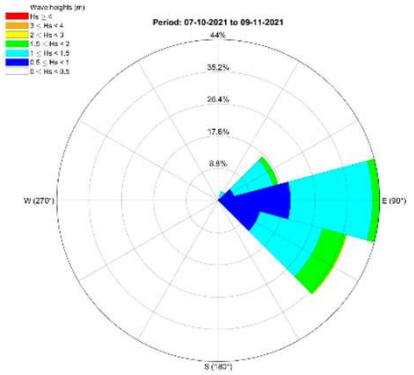
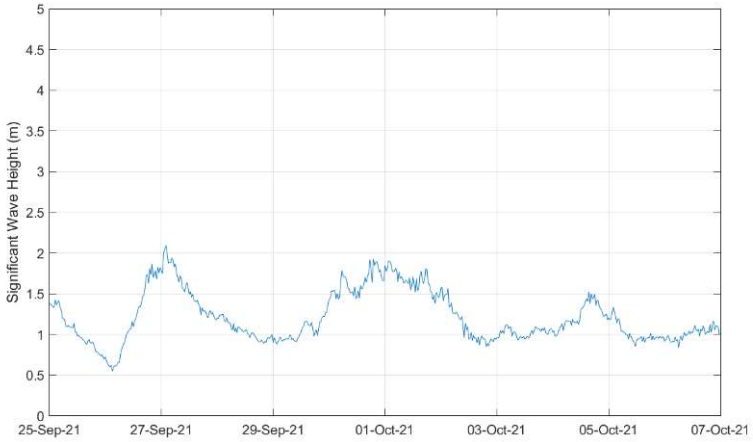
TWEED SAND BYPASSING

Tweed Sand bypassing is a joint project of the New South Wales and Queensland Governments, with the support of the Gold Coast City Council, and in conjunction with Tweed Shire Council.

Meters 0 50 100 150 200

Queensland Government





TWEEDSAND BYPASSING

TWEED RIVER ENTRANCE AS AT 9th NOVEMBER 2021

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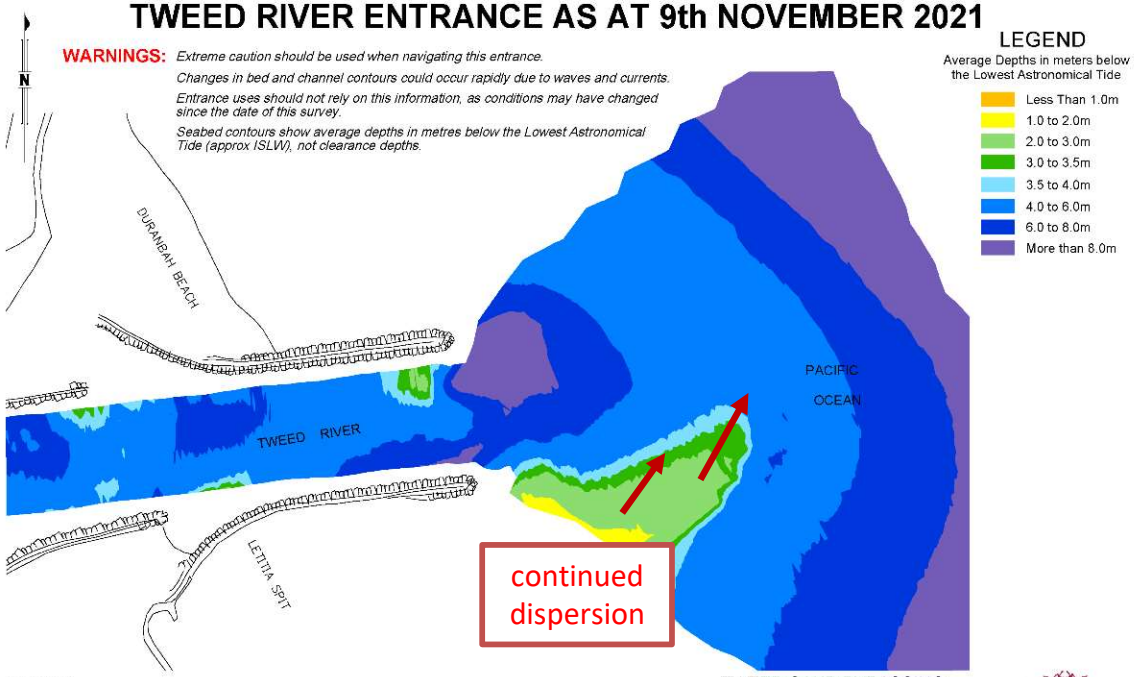

LEGEND

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- More than 8.0m

NOTES:

1. Survey information collected by Michel Group Services on 9th NOVEMBER 2021.
2. This plan prepared by Michel Group Services on 15th NOVEMBER 2021.
3. Surveys are undertaken for Tweed Sand Bypassing every three months to monitor entrance seabed levels.

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TWEED SAND BYPASSING

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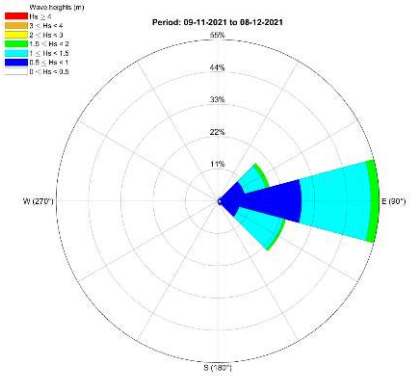
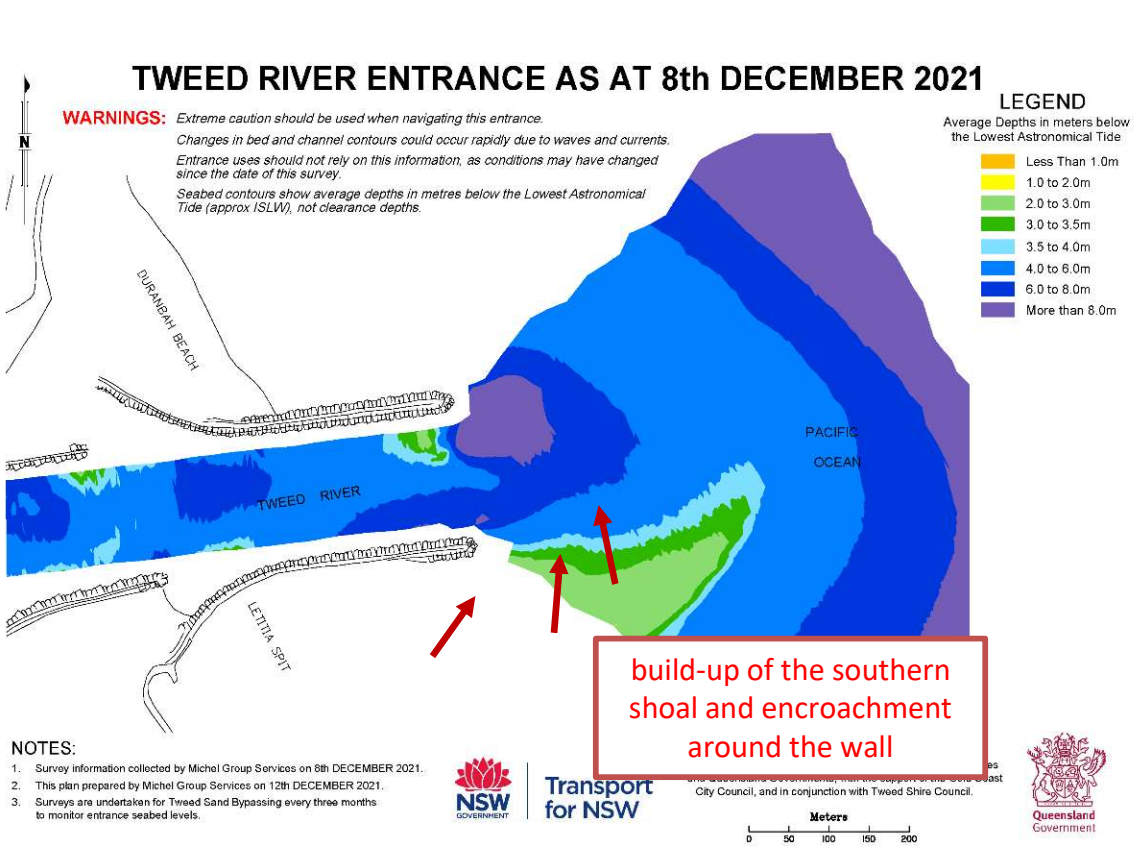
Meters: 0 50 100 150 200

Queensland Government




TWEED RIVER ENTRANCE AS AT 8th DECEMBER 2021
WARNINGS: Extreme caution should be used when navigating this entrance.
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LEGEND
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Less Than 1.0m
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2.0 to 3.0m
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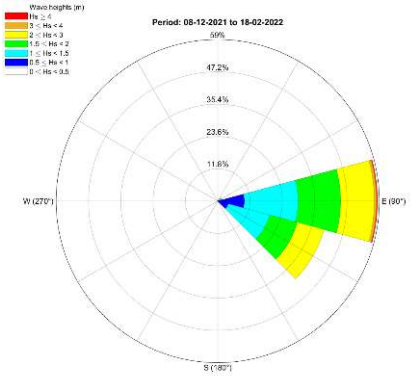
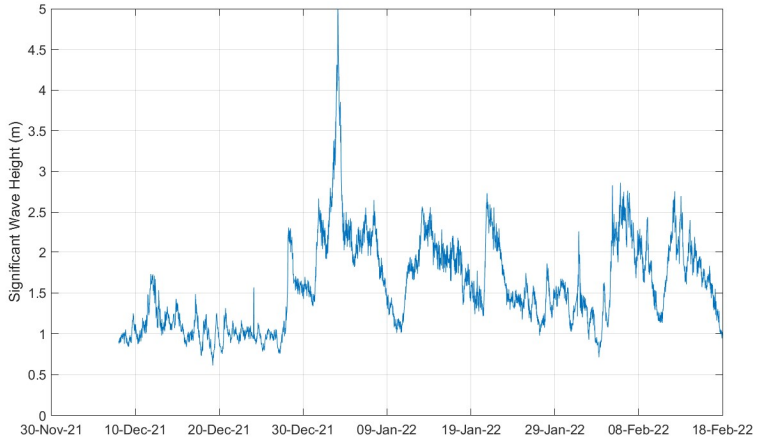
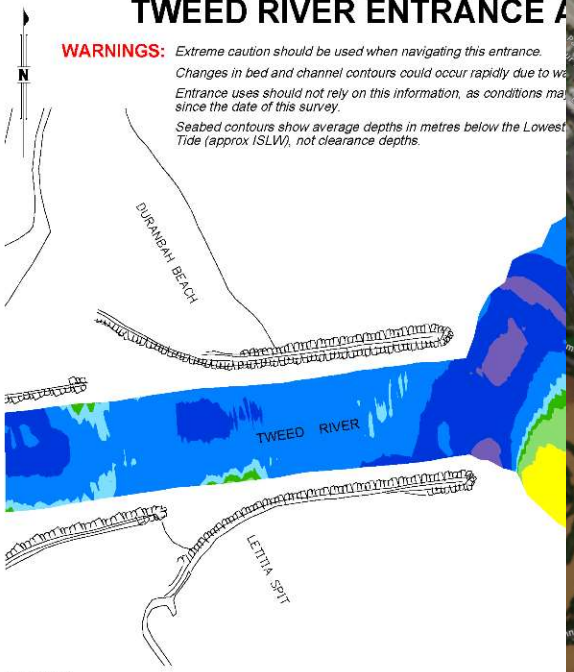
3.5 to 4.0m
4.0 to 6.0m
6.0 to 8.0m
More than 8.0m
N
DURANBAH BEACH
TWEED RIVER
PACIFIC OCEAN
LETITIA SPIT
build-up of the southern shoal and encroachment around the wall
NOTES:
1. Survey information collected by Michel Group Services on 8th DECEMBER 2021.
2. This plan prepared by Michel Group Services on 12th DECEMBER 2021.
3. Surveys are undertaken for Tweed Sand Bypassing every three months to monitor entrance seabed levels.
NSW GOVERNMENT
Transport for NSW
City Council, and in conjunction with Tweed Shire Council.
Meters
0 50 100 150 200
Queensland Government


Wave heights (m)
Hs ≥ 4
3 ≤ Hs < 4
2 ≤ Hs < 3
1.5 ≤ Hs < 2
1 ≤ Hs < 1.5
0.5 ≤ Hs < 1
0 ≤ Hs < 0.5
Period: 08-12-2021 to 18-02-2022
59%
47.2%
35.4%
23.6%
11.8%
W (270°)
E (90°)
S (180°)


Significant Wave Height (m)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
30-Nov-21
10-Dec-21
20-Dec-21
30-Dec-21
09-Jan-22
19-Jan-22
29-Jan-22
08-Feb-22
18-Feb-22

TWEEDSAND BYPASSING



Restoring Coastal Sand Drift - Improving Boating Access

NSW GOVERNMENT

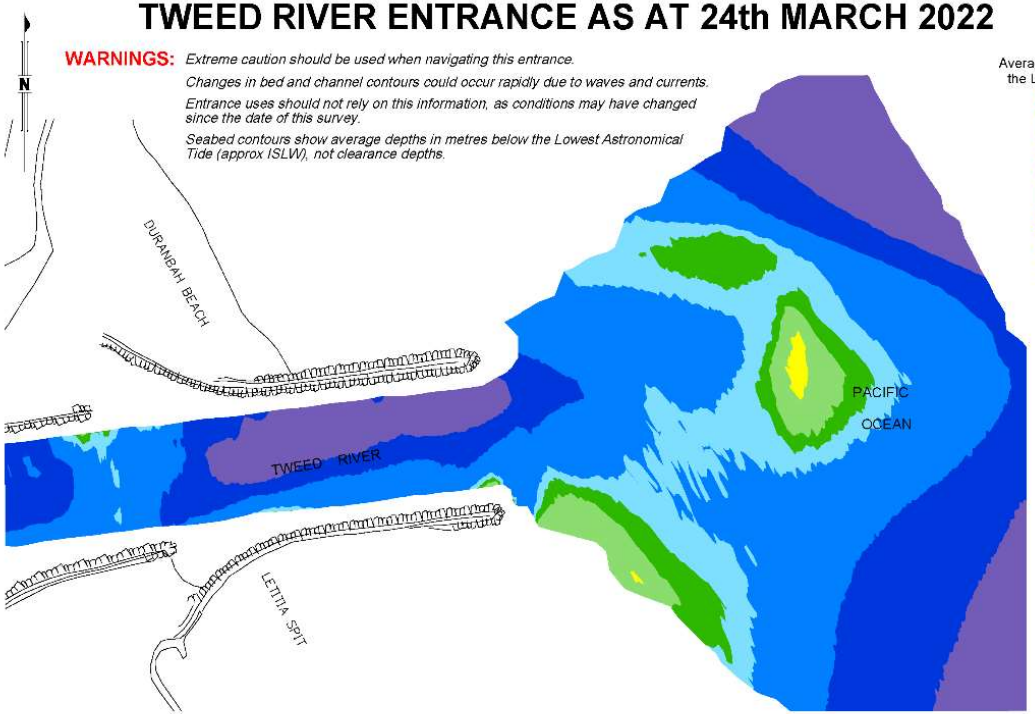
Queensland Government

TWEED SAND BYPASSING

Post-flood entrance morphology

TWEEDSAND BYPASSING

TWEED RIVER ENTRANCE AS AT 24th MARCH 2022



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- 4.0 to 6.0m
- 6.0 to 8.0m
- More than 8.0m

NOTES:

1. Survey information collected by Michel Group Services on 23rd & 24th MARCH 2022.
2. This plan prepared by Michel Group Services on 29th MARCH 2022.
3. Surveys are undertaken for Tweed Sand Bypassing every three months to monitor entrance seabed levels.

NSW GOVERNMENT | Transport for NSW

TWEED SAND BYPASSING

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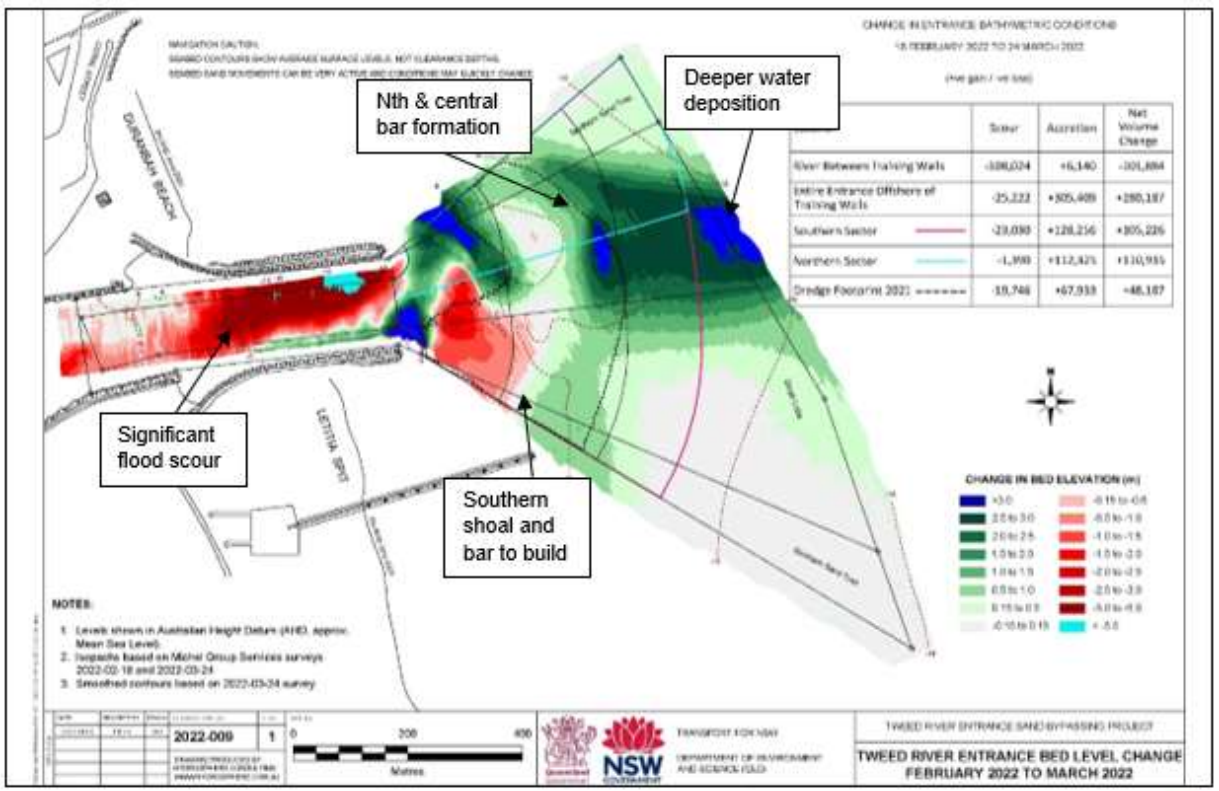
Meters

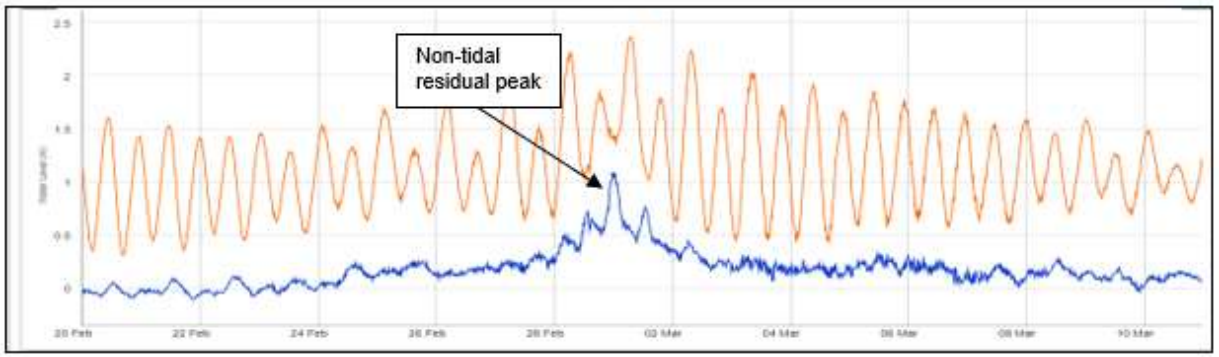
0 50 100 150 200

Queensland Government

NSW GOVERNMENT Queensland Government

Restoring Coastal Sand Drift - Improving Boating Access





Major flooding in the Tweed River occurred in March 2022. Water levels measured at the water intake jetty (figure bottom left) show a non-tidal residual of over 1m at the peak of the flood.

Significant scour of the riverbed between the training walls occurred with volume analysis indicating a loss of over 100,000m^3.

Scour of the ebb tide delta had a significant impact on the entrance shoals and bar.

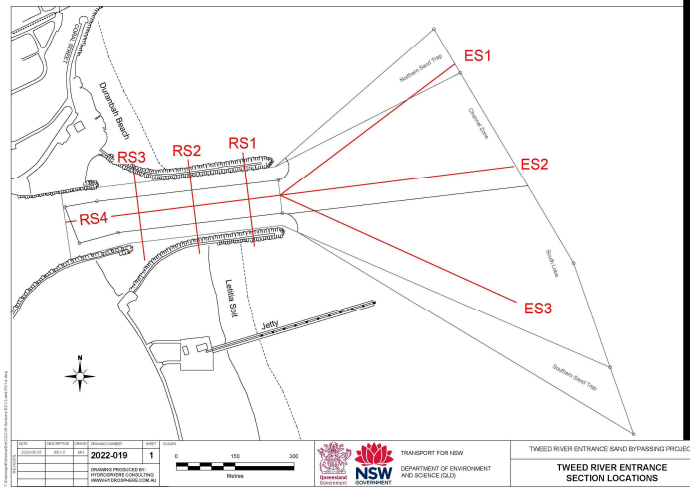
Complex entrance morphology is evident in the March hydrographic survey data and subsequent satellite imagery observations.

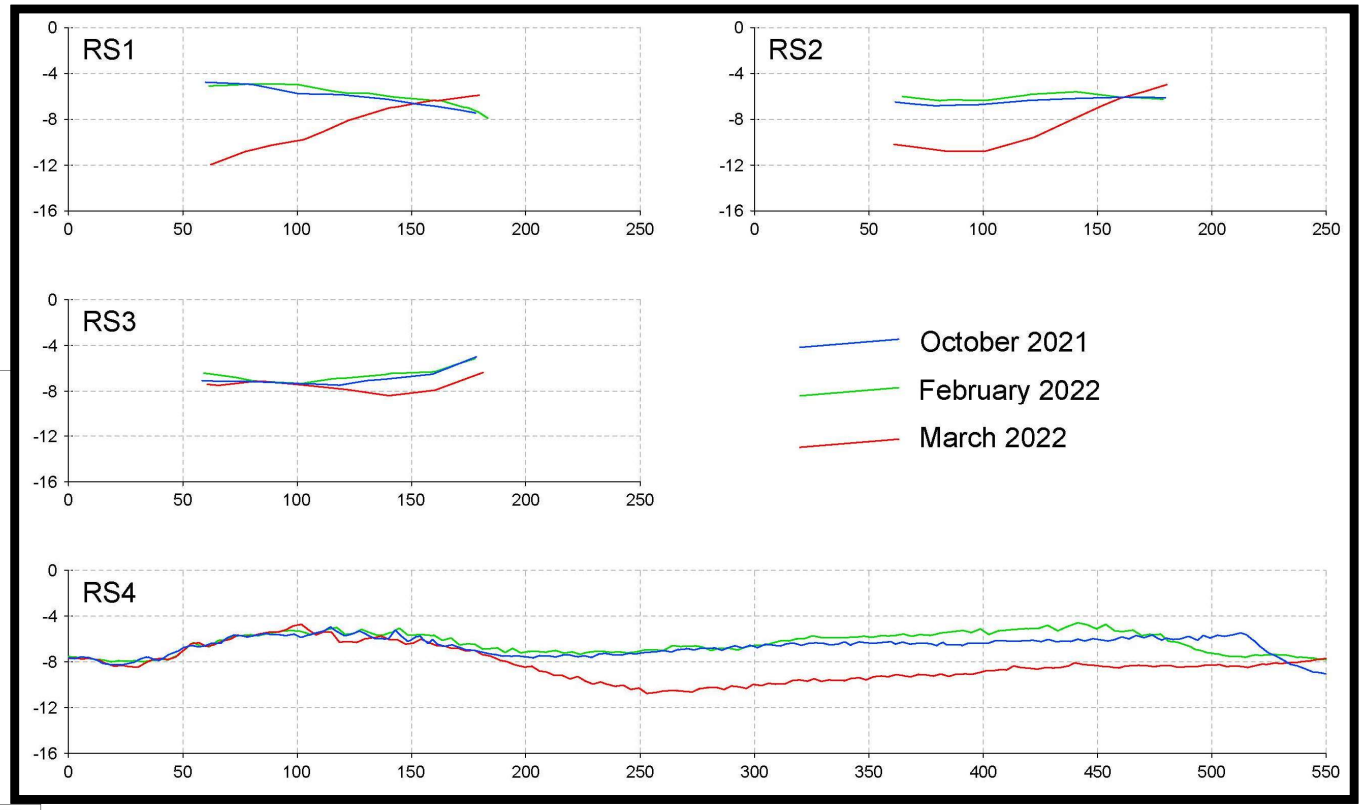
The bar is very shallow from the central through to northern compartments of the entrance. The southern shoal between the southern training wall and the jetty was dispersed somewhat by March wave/flood conditions.

Bypassing sediments will gradually infill scoured areas of the entrance (incl. between the training walls), however if wave energy remains high then development of the bar will also continue and may present a risk to entrance navigability.

Sediment that was deposited during the flood onto the outer ebb tide delta in deeper water should not impact navigability of the entrance.

MH1

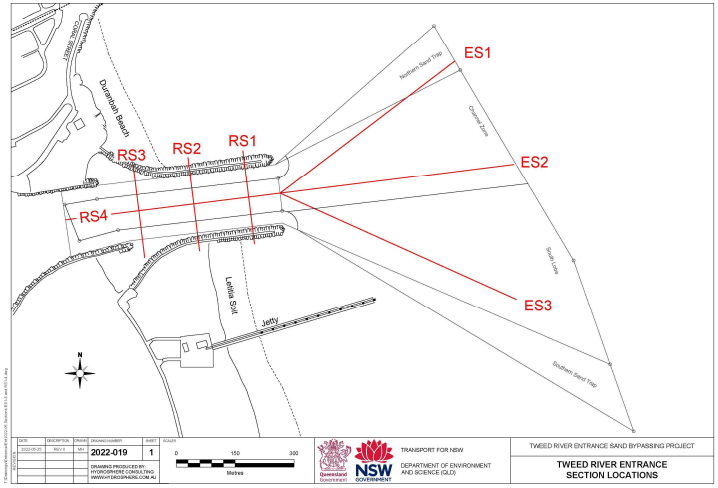

ES1
ES2
ES3
RS1
RS2
RS3
RS4
Dunbar Basin
Letitia Spit
Jetty
Northern Breakwall
Southern Breakwall
Queensland Shore
South Line
2022-019
TRANSPORT FOR NSW
DEPARTMENT OF ENVIRONMENT AND SCIENCE (QLD)
TWEED RIVER ENTRANCE SAND BYPASSING PROJECT
TWEED RIVER ENTRANCE SECTION LOCATIONS


RS1
RS2
RS3
RS4
October 2021
February 2022
March 2022

Slide 26

MH1 Matthew Harry, 29/05/2022

TWEEDSAND BYPASSING

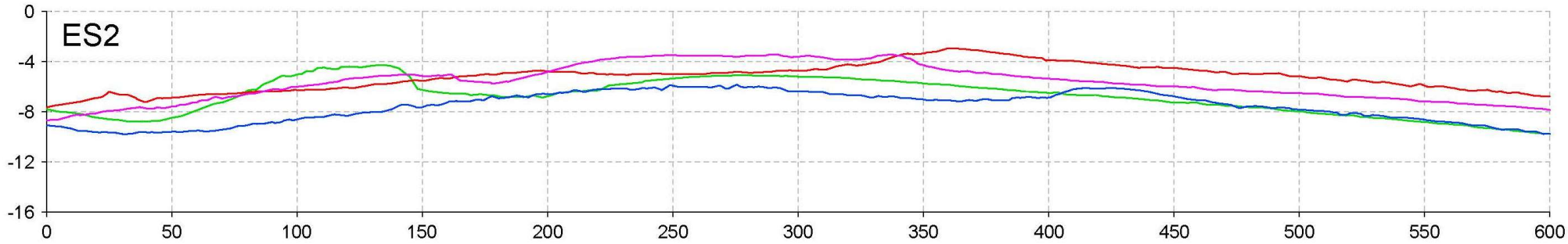


October 2021

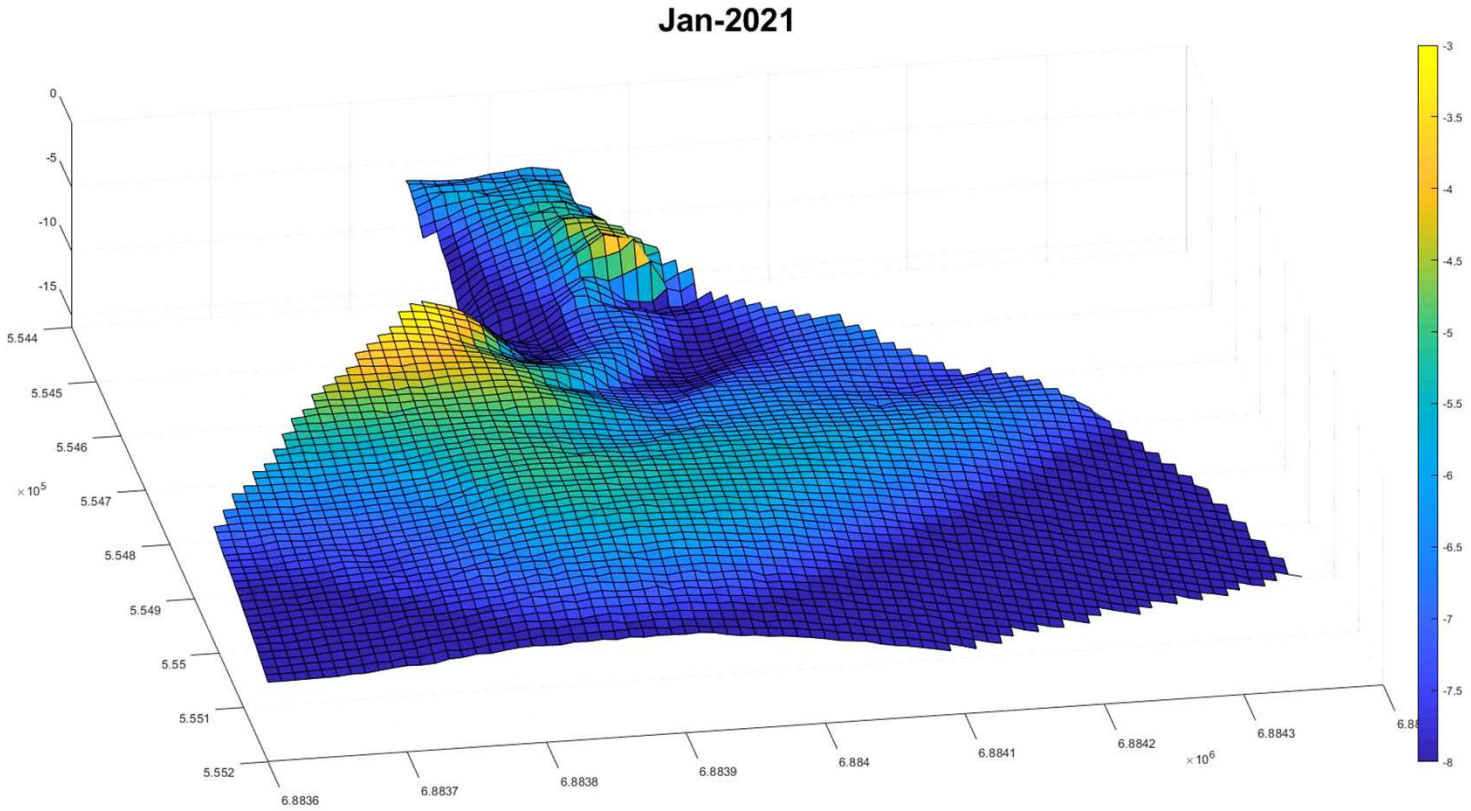
February 2022

March 2022

May 2022



TWEEDSAND BYPASSING

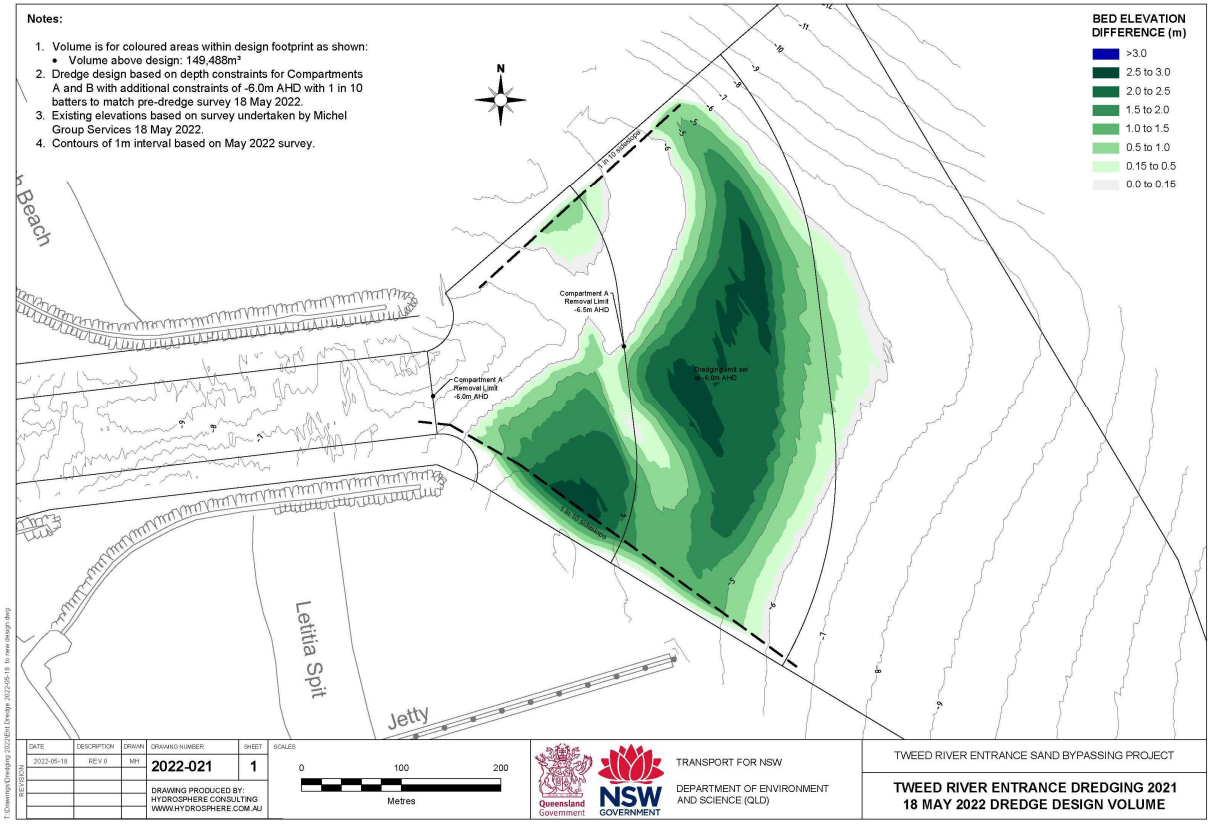


Restoring Coastal Sand Drift - Improving Boating Access

TWEED SAND BYPASSING

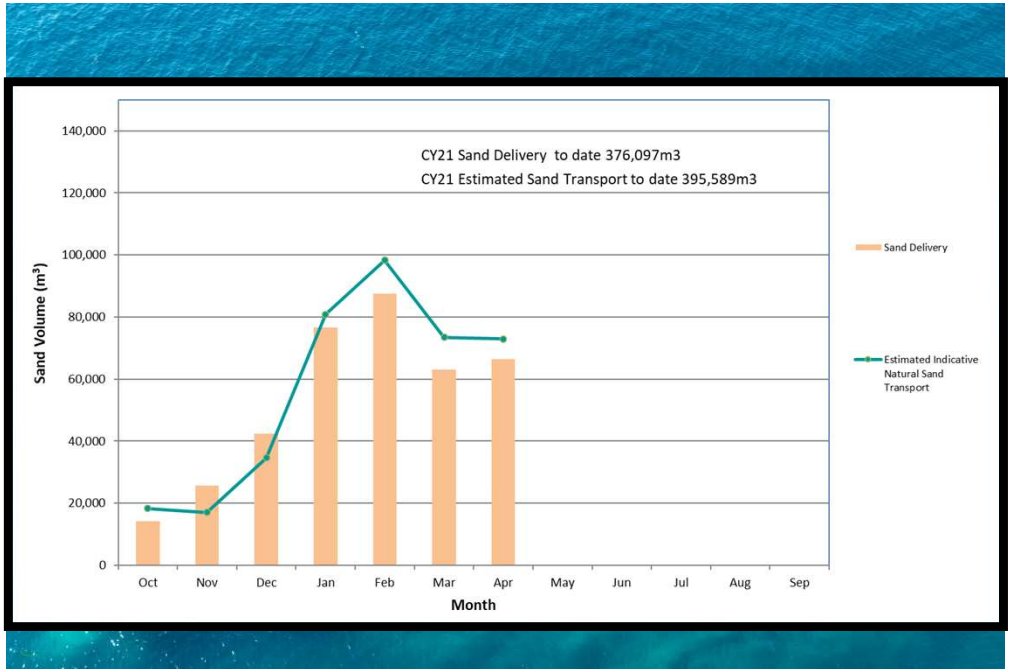
2022 dredge planning

TWEEDSAND BYPASSING



Dredge planning considerations

- Infill analysis intended to guide dredge design suitable for annual maintenance, i.e. sustainable volume removed each year to avoid a non-compliant navigation channel
- Post-2021 dredge campaign analysis variables:
  - Change in pumping operations
  - Record flood event
  - Significant pumping volumes
  - Significant longshore transport rates
- Ultimately the removal and placement design is based on pre-dredge surveys and project budget!



TWEEDSAND BYPASSING

Restoring Coastal Sand Drift - Improving Boating Access