REPORT

Tasman District Council

Jackett Island Long Term Erosion Management
Practicable Options Report

Tonkin & Taylor

ENVIRONMENTAL AND ENGINEERING CONSULTANTS

REPORT

Tasman District Council

Jackett Island Long Term Erosion Management
Practicable Options Report

Report prepared for:

Tasman District Council

Report prepared by:

Tonkin & Taylor Ltd

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Executive summary

This report sets out the assessment of practicable options to manage the erosion experienced along the seaward edge of Jackett Island to achieve the following objectives:

1. Reduce risk of erosion hazard affecting human life and physical assets
2. Restore the shoreline position to approximate the year 2000 shoreline
3. Provide a solution that considers the seaward edge of the Jackett Island shoreline for a period of 35 years (i.e. long term = 35 years), the maximum duration possible for a coastal permit.
4. Legitimise or remove existing groyne from the Coastal Marine Area.

It extends the discussion included in the preliminary practicable options report (T&T, 2011).

It has generally been agreed by Professor Kirk, Gary Teear, Ron Heath and Richard Reinen-Hamill that the system at this location is complex and is constantly evolving, rather than in a state of equilibrium. There are also significant fluctuations and changes to the system from year to year.

It has been identified that numerical modelling is not able to fully evaluate existing processes and the likely change of the system over years to decades in the future, but should provide a means of comparative assessment of options, which together with other assessments can give a degree of confidence on the possible outcomes of the various options being considered and assist in the identification of areas of risk and uncertainty.

Preliminary modelling and analysis of bathymetric data confirm the strong impact the ebb tide flows have along Jackett Island and the key erosion processes of:

- The southern end of the spit has been accumulating at a rate of around 61,000 m^3/yr
- Due to the relatively close proximity of the distal tip of the spit to Jackett Island, the strong tidal currents of the main channel are forced closer to Jackett Island further exacerbating the erosion is this area
- Sand eroded from the beach (across-shore due to the short-period waves) is then removed from the site by the tidal current that run parallel to the beach (both to the north and south)
- Reduced sediment supply to Jackett Island due to the presence of the main tidal channel between the spit and the Island. The sediment supply to Jackett Island was previously from the spit, with the biggest influxes occurring following breaching of the spit, with the remnant spit south of the new channel formed by the breach migrating shoreward to Jackett Island.

The developed practical physical work options are associated either with a new accessible navigation channel or modifications to the distal end of the spit and transfer of sand to rebuild the Jackett Island shoreline.

Both options require ongoing monitoring and maintenance, with the navigation channel providing additional benefit to the port users but a higher cost.

Numerical modelling will be used to compare the effects of the preferred approaches and will assist in identifying potential effects and maintenance requirements.

1 Introduction

This report sets out the assessment of practicable options to manage the erosion experienced along the seaward edge of Jackett Island, progressing options identified in our practicable option report.

2 Current progress

Consents are currently being sought for the removal of the full removal of the existing groyne. Ongoing monitoring would be required and exposed areas of groyne removed as it becomes exposed.

A workshop was held in Nelson with Port representatives including Gary Teear (Ocel) and Ron Heath and on 3rd February 2012 and a meeting of local residents/stakeholders on 8th February 2012.

A report from Professor Bob Kirk (2011) regarding coastal issues at Jackett Island, Moutere Inlet Motueka (December, 2011).

Ron Heath (2012) draft report on Motueka Sand Spit, Jackett Island erosion and the entrance to Motueka Harbour

Numerical model studies are in progress and currently field investigations are currently being carried out in order to calibrate the model and update understanding of the existing physical system and drivers.

3 The current understanding of coastal processes

3.1 General context

It has generally been agreed by Professor Kirk, Gary Teear, Ron Heath and Richard Reinen-Hamill that the system at this location is complex and is constantly evolving, rather than in a state of equilibrium. There are also significant fluctuations and changes to the system from year to year.

It has been identified that numerical modelling is not able to fully evaluate existing processes and the likely change of the system over years to decades in the future, but should provide a means of comparative assessment of options, which together with other assessments can give a degree of confidence on the possible outcomes of the various options being considered and assist in the identification of areas of risk and uncertainty.

3.2 Analysis of hydrographic survey results

An assessment of volume stored in the spit was made by comparing the November 2011 survey with the 1997 survey (refer Appendix A). Some 860,500 m^3 of accretion has occurred to south of the 1997 spit over this 14 year period, equating to an average accretion rate of around 61,000 m^3/yr. This is in the same order of magnitude as Kirk's (1990) upper bound assessment of alongshore drift of 47,500 m^3/yr.

3.3 Preliminary numerical model results

MetOCean Ltd is currently engaged in the numerical model study. The following figures show initial velocity plots for incoming and outgoing tides through the Moutere Inlet. These plots were used to establish the location of current measurement devices to enable calibration of the model.

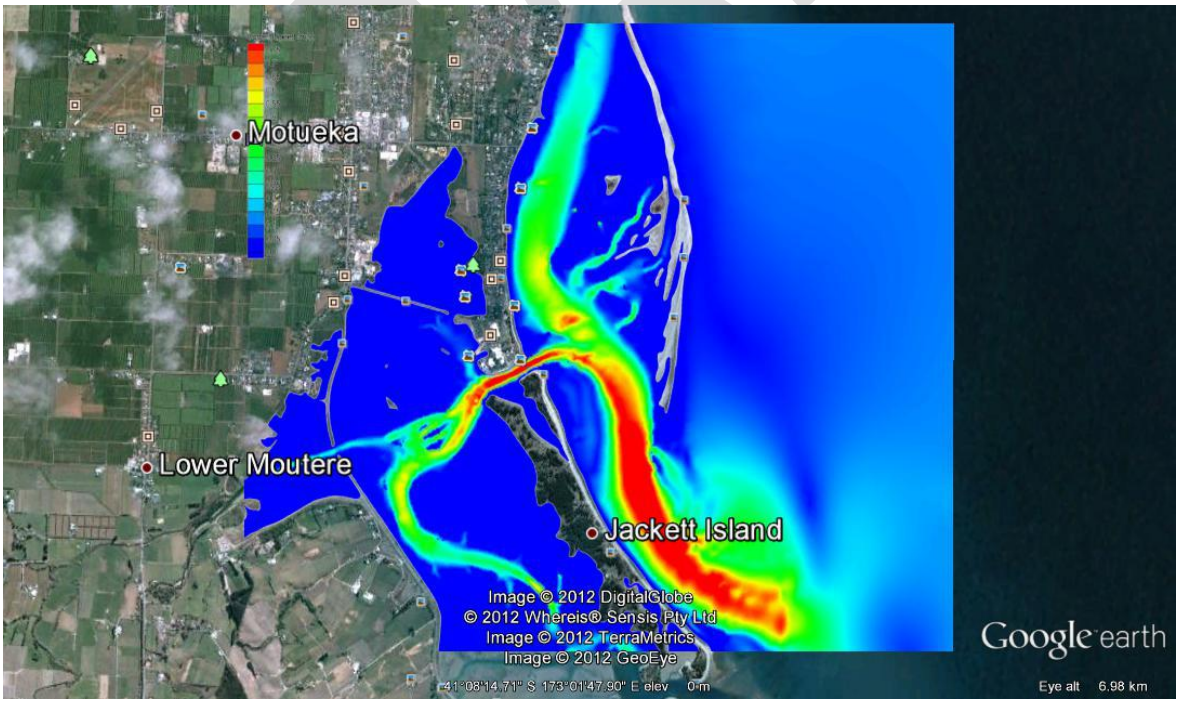

Figure 3-1 Preliminary model results of peak outgoing (ebb) tidal velocity (Source: MetOcean, 2012)

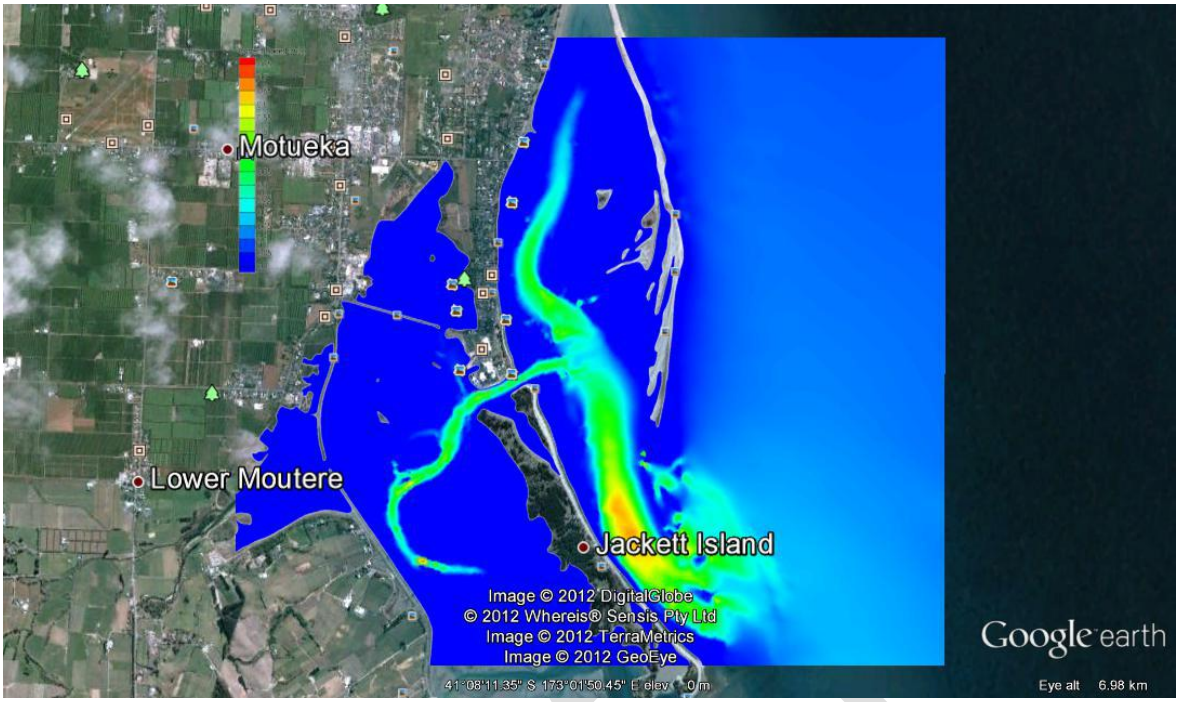

Figure 3-2 Preliminary model results of peak incoming (flood) tidal velocity (Source: MetOcean, 2012)

These figures confirm the strong impact the ebb tide flows have along Jackett Island and the key erosion processes of:

- Due to the relatively close proximity of the distal tip of the spit to Jackett Island, the strong tidal currents of the main channel are forced closer to Jackett Island further exacerbating the erosion is this area, and;
- Sand eroded from the beach (across-shore due to the short-period waves) is then removed from the site by the tidal current that run parallel to the beach (both to the north and south);
- Reduced sediment supply to Jackett Island due to the extended length of the spit and the relative close proximity of the distal tip. The sediment supply to Jackett Island is from the spit, with the biggest influxes occurring following breaching of the spit, with the remnant spit south of the new channel formed by the breach migrating shoreward to Jackett Island.

4 Practicable options

The practicable options developed below were based on the preliminary practicable options and the initial feedback from Professor Bob Kirk (December 2011) and considerations included in Heath's draft report (2012).

The aim of the practicable option development is to refine potential physical works options to model and to identify opportunities and constraints of the options. Other non-physical works options such as planning responses, etc identified in the preliminary practical options report are not included in this assessment, but should remain possible options to evaluate against any developed physical works option.

We note the comment of Professor Kirk that possible solutions should not be put forward ahead of a technically credible understanding of the causes or outcomes.

4.1 Existing channel maintenance and beach nourishment

No further development of this option has been made from the preliminary practical options report, but the text is included for completeness and the volume of sand required to nourish the Jackett Island foreshore has been confirmed based on the hydrographic and LIDAR survey data which is discussed in more detail in Section 4.2 below and included in Figure 20 in Appendix A.

This option involves regular mechanical bypassing of sand from the distal end of the spit to Jackett Island, replicating the natural process when the spit was shorter and sand bars are more able to migrate shoreward without being affected by the ebb tide outflow. A conceptual sketch of this option is shown on Figure 6 of the preliminary practical options report. The works would involve an initial capital dredge of the landward side of the spit and transfer of this sand along the seaward edge of Jackett Island to realign the existing channel further seaward from its current position.

It is estimated that around 150,000 m^3 of sand would need to be placed along the foreshore of Jackett Island to restore the shoreline to the 2000 shoreline position. This was based on protection of up to 1000 m of shoreline with a beach slope of 20(H):1(V) extending from around RL 5 m to RL 3 m and a 40(H):1(V) slope from RL3 to intersect with the existing seabed. The extent of shoreline was taken from an assessment of the most recent aerial photograph with the aerial photograph from 2000 and consideration of the local bathymetry. The sediment grain size of the spit (Kirk, 1990) shows medium fine sand that should be stable at 20(H):1(V) at this location which could reduce the volume to around 100,000 m^3. However, we recommend the upper volume being used at this stage as additional material may be require due to the erosion process being ongoing.

After the initial placement, regular transfer of sand would be required to maintain the channel position away from Jackett Island and to maintain the beach position. The rate of sand loss along Jackett Island is estimated to be around 10,000 m^3/yr (lower and upper bound range is 7,400 m^3/yr and 12,800 m^3/yr respectively) which is less that the longshore drift rate of 47,500 m^3/yr estimated to occur along the spit.

This work could be done by a cutter suction dredge with a slurry pump discharging the dredged sand to the Jackett Island shoreline. Initial costing of dredging is based on indicative costs of sand dredging of \$10/m^3 presented by OCEL for the Motueka Port Users Ltd[1] that included mobilization

[1] OCEL (2011). Establishing and maintaining a new navigation channel for Port Motueka (Draft). Unpublished report for Motueka Port Users Ltd. May 2011.

costs, but not for contingencies, engineering and environmental costs (design/contract supervision/monitoring etc) and also not for the costs of placement and shaping of sand along the Jackett Island shoreline. We have included additional cost for P&G (10%), sand shaping and management along Jackett Island of $6/m^3$, 20% contingency and 30% for engineering and environmental management. Based on this approach the preliminary estimates of initial cost for this option is in the order of $3.8M.

Annual maintenance costs assuming a similar distribution of costs but with a smaller volume could range between $200,000 and $330,000 per annum.

This option would effectively maintain the existing situation in terms of channel orientation and improve the erosion situation along Jackett Island through active management. It also has the benefit of limiting dredging within the more sensitive ecological areas of the spit. However, it would not result in the potential for the natural system to be restored and would need ongoing maintenance and monitoring costs unless alternative land management options were brought in over time that reduced the need for ongoing maintenance works, or a natural breach occurs increasing sediment supply to Jackett Island.

4.2 New access channel dredging and beach nourishment

This option is discussed in the draft report prepared by OCEL for the Port Motueka User Group (PMUG). The objective is to dredge a channel across the spit, based on the recommendation by Kirk (1991) to provide improved access to the port. This option has been extended to identify the area of beach nourishment adjacent to Jackett Island to restore the shoreline to around the 2000 position.

This option has been revised from the preliminary practical options report and included as Figure 20 to 22 in Appendix A. The proposal as illustrated in Figure 20 and involves a channel 50 m wide set at 3 m below Nelson Vertical Datum (or approximately Mean Sea Level). Two locations are indicated on the plan, one more perpendicular to the incident wave energy (but note, not fully perpendicular to the main incident wave energy) and one more aligned to the adjacent seabed contours. Numerical modelling would be used to evaluate the velocity and flows through this channel and the shear stress acting on the formed channel to evaluate the stability of the channel dimensions.

Preliminary numerical modelling work included in Section 3 shows the alignment perpendicular to the seabed contours may be more aligned to the combined flows from the Moutere inlet and the area between the Spit and Motueka compared to the more wave aligned channel. Optimising the channel alignment would be done using the calibrated numerical model.

Based on the channel cross section the sand volume is around 194,000 m^3 for the wave perpendicular option and around 147,000 m^3 for the seabed perpendicular channel option. The long section through the dredged channel and the cross sections are shown on Figure 21 for the wave perpendicular option.

There may be the need to enhance or extend the existing training groyne on the right side of the Moutere outlet to train the flows from both the Moutere Inlet and the flows from the area between Motueka Spit and Motueka (refer Figure 3-2). OCEL proposed an extension of the gravel berm to the end of the existing training wall would be sufficient in combination with the flows from the inlet through the new opening being sufficient to reinforce the new channel position and that full closure of the existing channel would not be required. Based on the preliminary modelling discussed in Section 3, this may not be sufficient to train the flow and a longer structure

may be required. Numerical modelling of would be used to confirm the requirement for training works.

Sedimentation rates within the dredged channel of between 14,250 and 23,750 m^3/yr were estimated by OCEL based on work done by Kirk (1990). Heath (2012) estimated sediment transport capacity over an outgoing tide is in excess of 115,000 m^3 based on 30% of the tidal flows being directed through the channel, suggesting that ebb flows could maintain the channel and that sand periodically trapped in the channel would be transported seaward and be able to be transported along shore by wave energy.

The construction process would need to include stockpiling sand in an area relatively protected from tidal flows and wave energy until the channel was formed and flows (or a proportion of flows) diverted from the existing channel. The most likely location for this temporary stockpile would be immediately to the south of the training groyne. This would also improve the flow concentration during ebb tides through the newly formed channel. Sand from this stockpile would need to be transported along to the central Jackett Island foreshore and placed along the shoreline to restore the shoreline to 2000 levels. The lower bound sand dredge volume for the perpendicular to bathymetry option of 147,000 m^3 is similar to the estimated upper bound nourishment volume of 150,000 m^3. If the wave aligned channel was chosen, not all the sand would need to be transported to Jackett Island and some could be returned to the coastal environment to the south of the channel.

Initial costing of dredging is based on indicative costs of sand dredging of \$10/m^3 presented by OCEL (2011) for the Motueka Port Users Ltd included mobilization costs, but not any allowance for contingencies, engineering and environmental costs (design/contract supervision/monitoring etc) and also not for the costs of placement and shaping of sand along the Jackett Island shoreline. Therefore, OCEL's cost estimate of \$1.4M is unlikely to cover the actual costs of the proposed activities required to maintain the coastal edge along Jackett Island.

To provide a comparative costing assessment with our channel maintenance option we have included additional cost for P&G (10%), sand shaping and management along Jackett Island of \$8/m^3, 20% contingency and 30% for engineering and environmental management. The sand transfer is higher than the previous option as there is a longer haul required to move sand in this option. We have assumed 194,000 m^3 is dredged and 150,000 m^3 is transferred to the shoreline along Jackett Island. Based on this approach the preliminary estimates of initial cost of the PMUG option is in the order of \$5.0 M.

Annual maintenance costs including the transfer of a portion of the sand to Jackett Island could range between \$200,000 and \$330,000 per annum. However, if the new channel functioned as desired, then there may be less need to transfer sand to Jackett Island and the by-passing would involve transfer of sand to a location down drift (south) of the new channel.

This option would work towards restoring the situation at the spit that existed prior to the geotextile groyne being constructed and would also provide a mechanism to manage erosion along Jackett Island. It has a wider benefit than just for the management of erosion to Jackett Island residents.

Maintaining the flows through this channel location would result in the southern spit migrating towards land as the hydraulic control from the existing channel flow would not be present. This is likely to result in the southerly migration of the channel unless maintenance works were carried out to maintain the channel position in the original location. Alternatively an envelope of acceptable movement could be agreed where dredging to restore the channel would only be contemplated once the channel migrated outside the envelope.

There are risks associated with the training groyne extension which require further assessment. This option also needs ongoing maintenance and monitoring both for the channel opening and the erosion along Jackett Island.

4.3 Summary

Work is ongoing to characterise the existing environment with the numerical model study likely to provide a good tool for analysis. However, the existing system is complex and may be in a state of evolution rather than dynamic equilibrium so numerical modelling is unlikely to be able forecasting the likely changes and effects over years to decades.

The developed practical physical work options are associated either with a new accessible navigation channel or modifications to the distal end of the spit and transfer of sand to rebuild the Jackett Island shoreline.

Both options require ongoing monitoring and maintenance, with the navigation channel providing additional benefit to the port users but a higher cost.

Numerical modelling will be used to compare the effects of the preferred approaches and will assist in identifying potential effects and maintenance requirements.

5 Applicability

This report has been prepared for the benefit of Tasman District Council with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

Tonkin & Taylor Ltd

Environmental and Engineering Consultants

Report prepared by:	Authorised for Tonkin & Taylor Ltd by:
.....	.....
Richard Reinen-Hamill	Tim Fisher
Senior Coastal Engineer	Project Director

RRH

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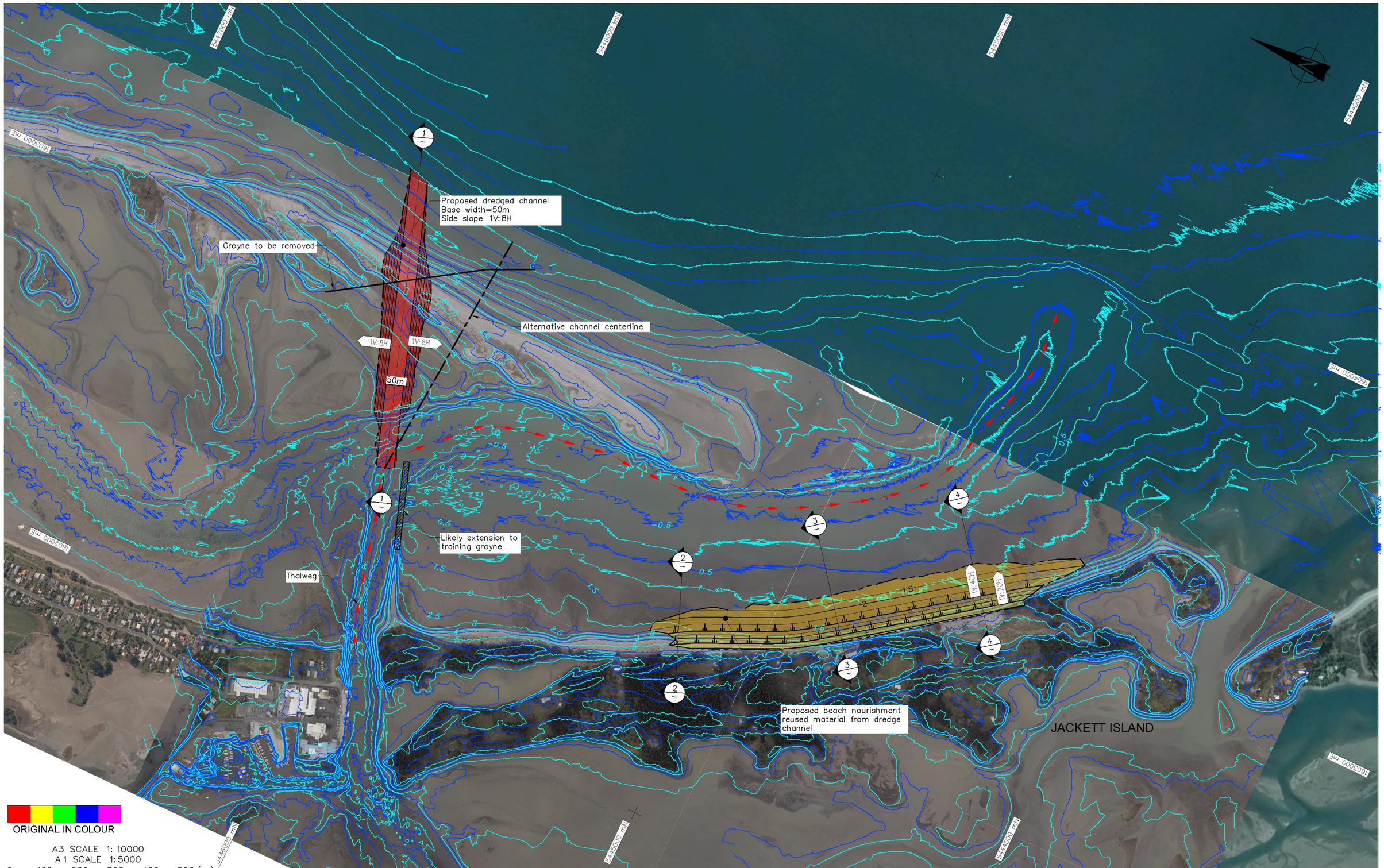
References

Heath, R., 2012, Motueka Sand Spit, Jacket Island erosion and the entrance to Motueka Harbour – a working document (DRAFT).

Kirk, R.M., 1990, Coastal sedimentation and navigability at Port Motueka, Moutere Inlet. Unpublished report to Tasman District Council, July 1990.

Ocel, 2011, Establishing and maintaining a new navigation channel for Port Motueka [Draft]. Unpublished report for Moteka Port Users Ltd, May 2011

Appendix A: Change in levels of the Motueka Spit south of the 1997 bathymetry



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A1 SCALE 1: 5000

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LEGEND

- Existing Combine Contour (0.5m Interval)
- 1.0 Existing Combine Contour (1.0m Interval)
- Proposed Batter
- Proposed Extent of Works
- Proposed Contour (0.5m Interval)
- 1 Proposed Contour (1.0m Interval)

NOTES:
1. All dimensions in metres unless noted otherwise
2. Aerial photo supplied by Tasman District Council dated 2011
3. Hydrographic survey data supplied by Eliot Sinclair dated 2011 Nov.
4. Lidar Data Supplied by Tasman District Council dated 2011
5. Horizontal Datum: NZTM, New Zealand Transverse Mercator
   Vertical Datum: Chart Datum, 2.20m below MSL/Nelson VD 1955,
   Origin of Levels: N60 (AC4J) Rothmans Monument, RL 6.452

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JACKETT ISLAND

Preliminary Preferred Option

Plan

FIG. No. Figure 20

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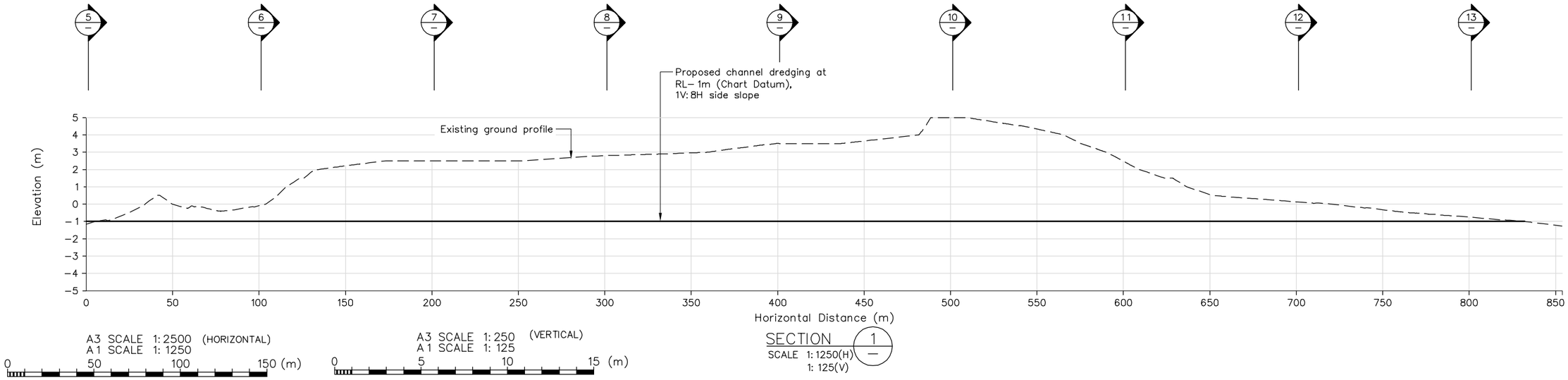

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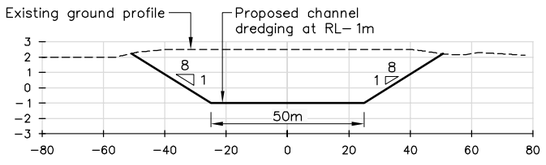

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SECTION 6
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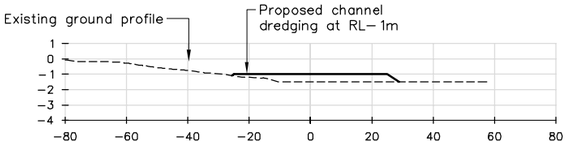

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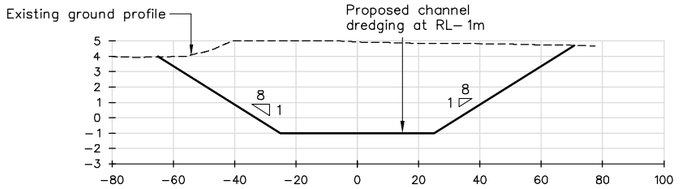

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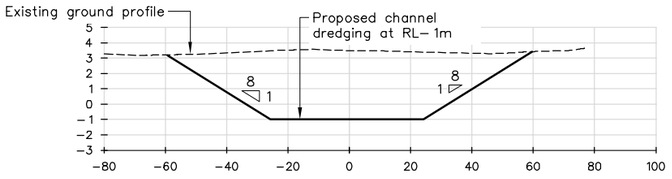

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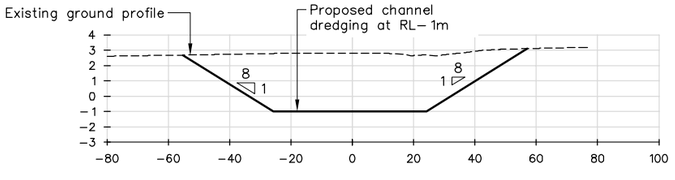

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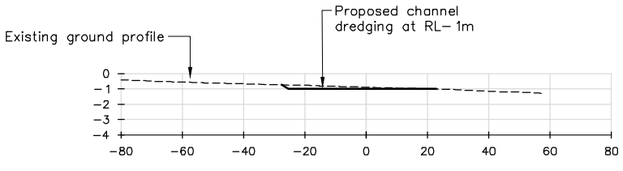

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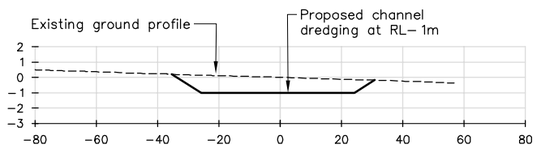

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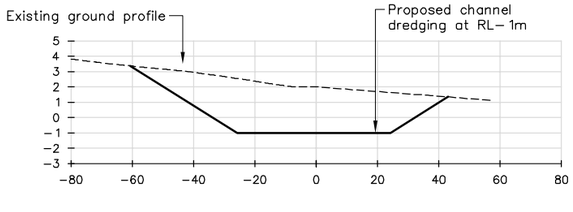

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A3 SCALE 1: 400 (VERTICAL)
A1 SCALE 1: 200
0 5 10 15 20 25 (m)

NOTES:
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   Origin of Levels: N60 (AC4J) Rothmans Monument, RL 6.452

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JACKETT ISLAND
Sections (Sheet 1 of 2)

FIG. No. Figure 21
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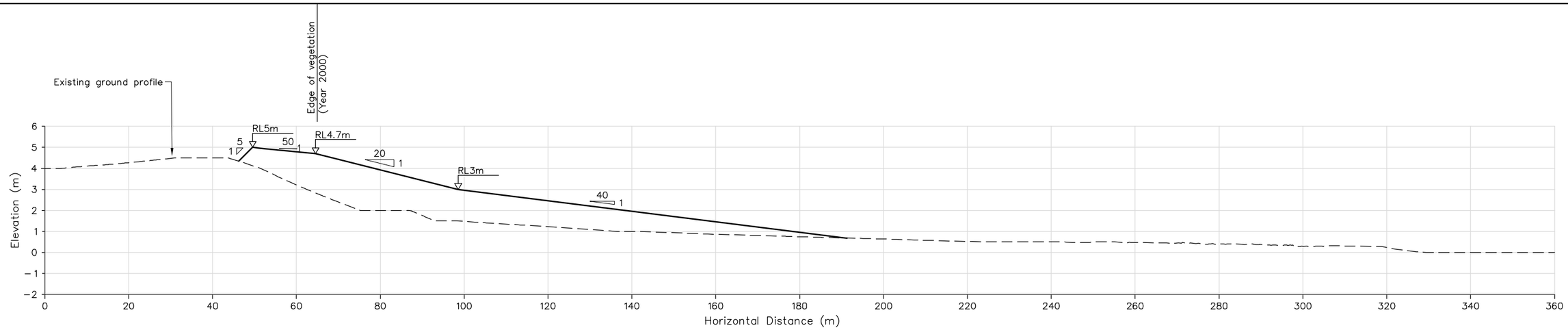

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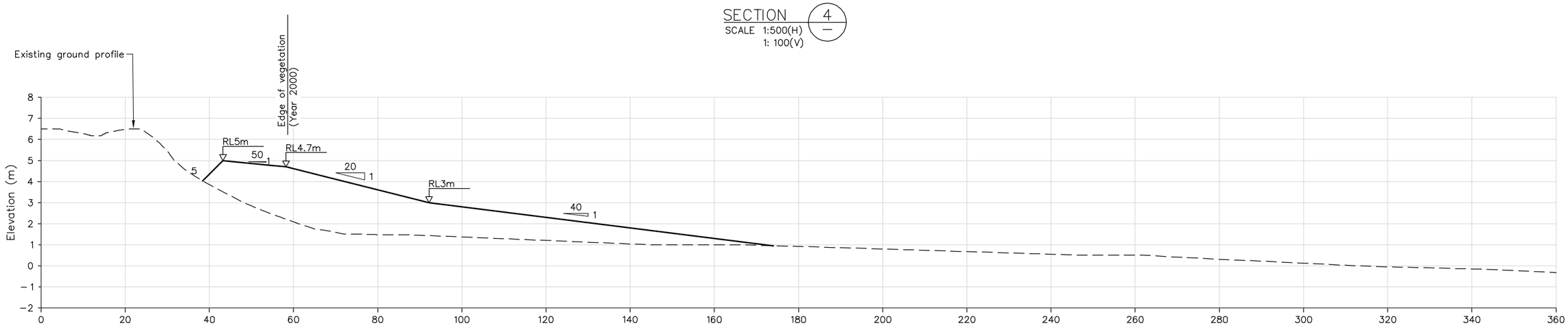

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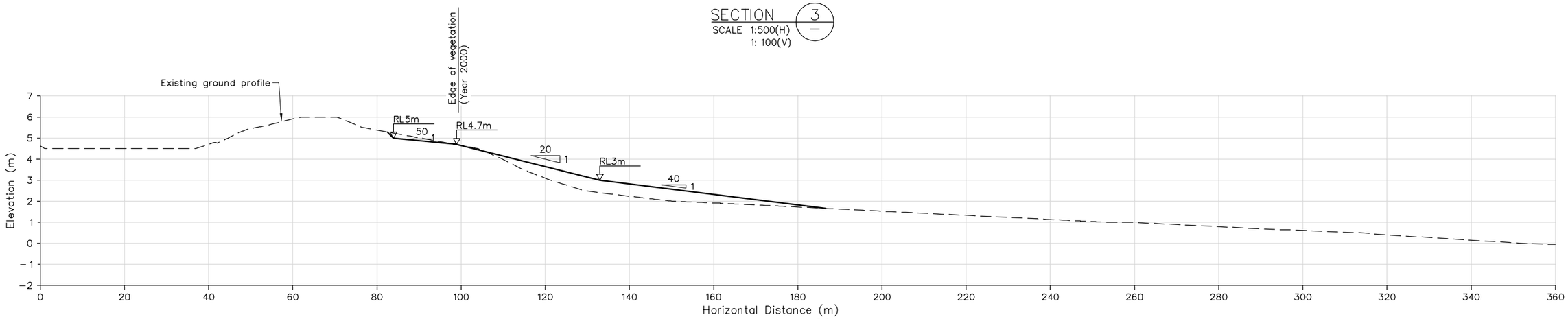

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Preliminary Preferred Option
Sections (Sheet 2 of 2)

FIG. No. Figure 22

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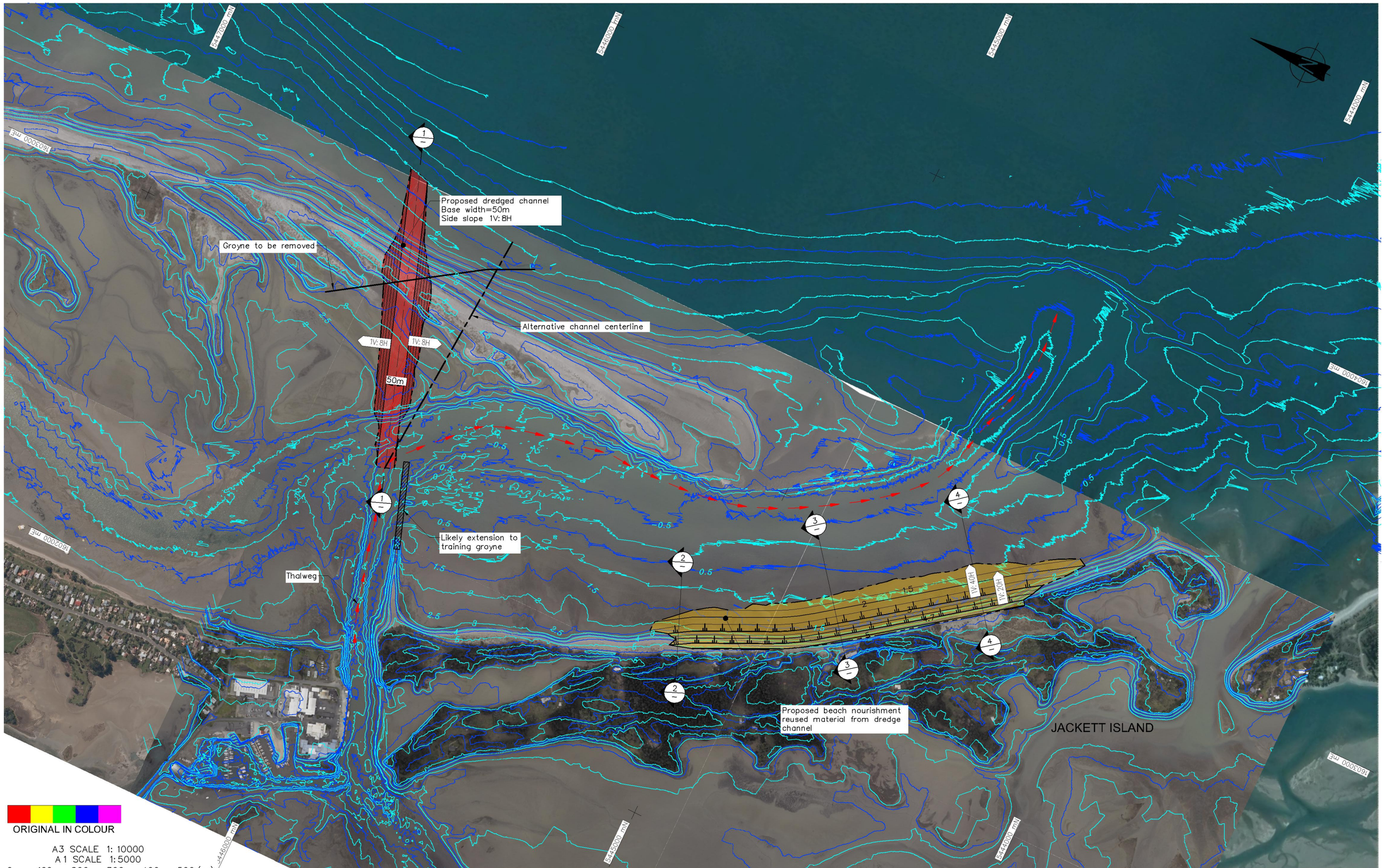
Appendix B: Preliminary preferred option: port navigation channel



ORIGINAL IN COLOUR

A3 SCALE 1: 10000
A1 SCALE 1: 5000

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LEGEND

- Existing Combine Contour (0.5m Interval)
- 1.0 Existing Combine Contour (1.0m Interval)
- Proposed Batter
- Proposed Extent of Works
- Proposed Contour (0.5m Interval)
- 1 Proposed Contour (1.0m Interval)

NOTES:
1. All dimensions in metres unless noted otherwise
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Plan

FIG. No. Figure 20

REV. 0

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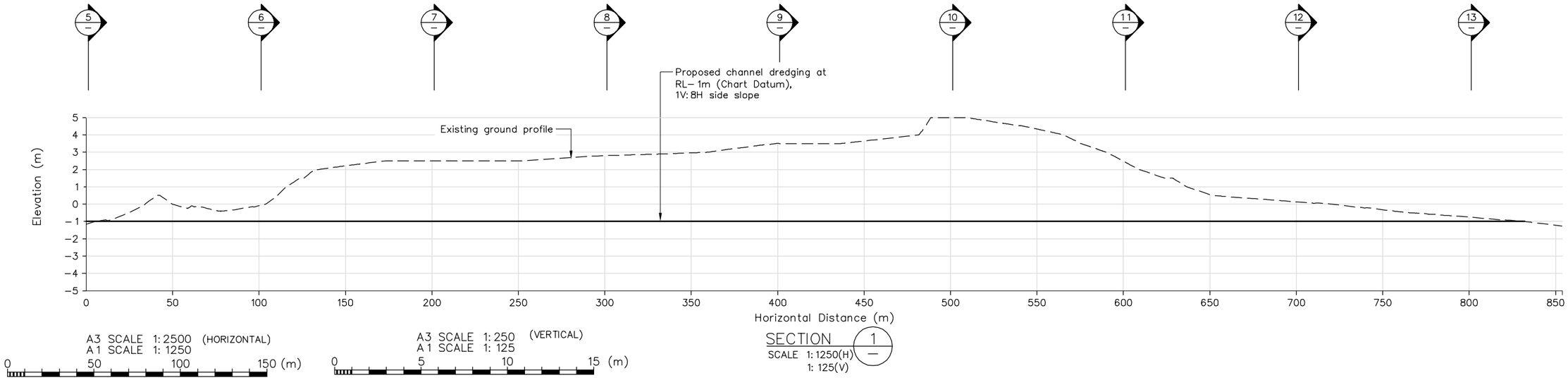
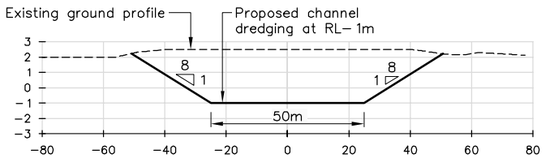


SECTION 1
SCALE 1: 1250(H)
1: 125(V)

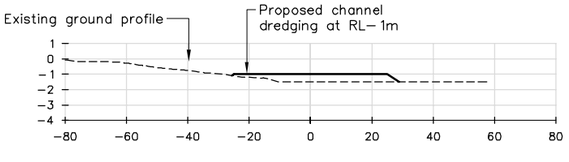
A3 SCALE 1: 2500 (HORIZONTAL)
A1 SCALE 1: 1250
0 50 100 150 (m)

A3 SCALE 1: 250 (VERTICAL)
A1 SCALE 1: 125
0 5 10 15 (m)

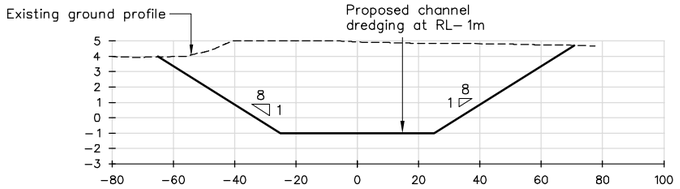


SECTION 7
SCALE 1: 1000(H)
1: 200(V)

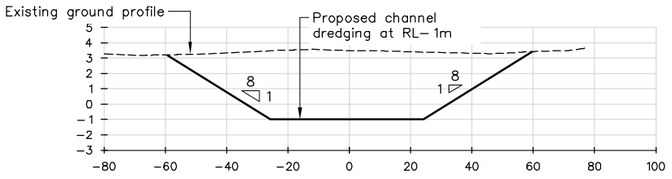
SECTION 6
SCALE 1: 1000(H)
1: 200(V)



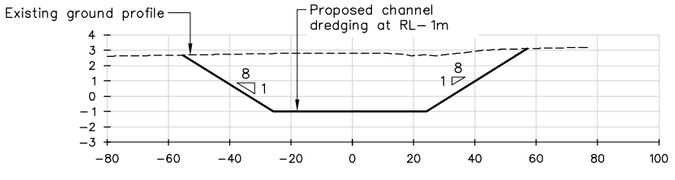
SECTION 5
SCALE 1: 1000(H)
1: 200(V)



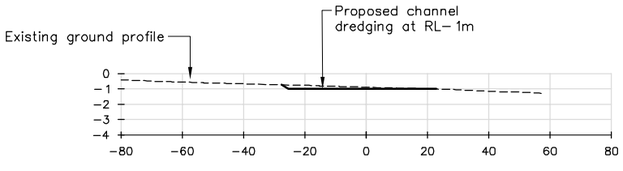
SECTION 10
SCALE 1: 1000(H)
1: 200(V)



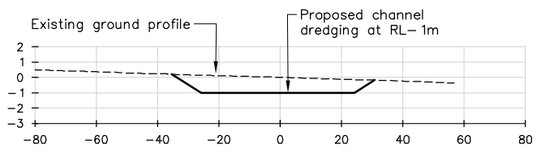
SECTION 9
SCALE 1: 1000(H)
1: 200(V)



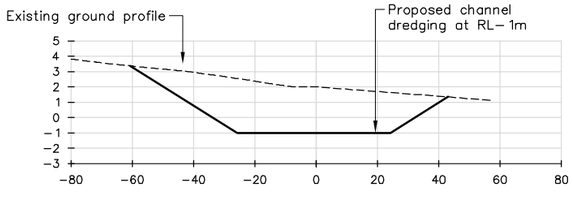
SECTION 8
SCALE 1: 1000(H)
1: 200(V)



SECTION 13
SCALE 1: 1000(H)
1: 200(V)



SECTION 12
SCALE 1: 1000(H)
1: 200(V)



SECTION 11
SCALE 1: 1000(H)
1: 200(V)

A3 SCALE 1: 2000 (HORIZONTAL)
A1 SCALE 1: 1000
0 10 20 30 40 60 80 100 (m)

A3 SCALE 1: 400 (VERTICAL)
A1 SCALE 1: 200
0 5 10 15 20 25 (m)

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TASMAN DISTRICT COUNCIL
JACKETT ISLAND
Sections (Sheet 1 of 2)

FIG. No. Figure 21
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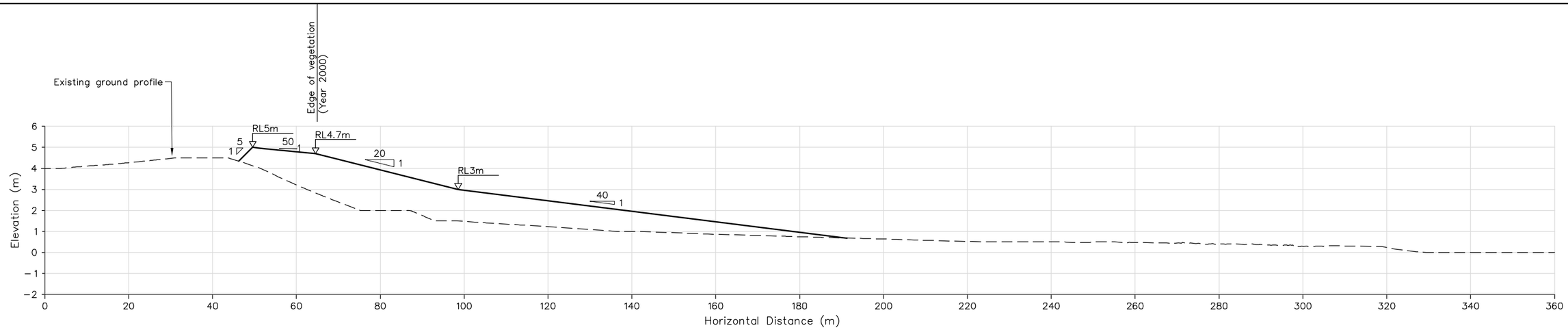
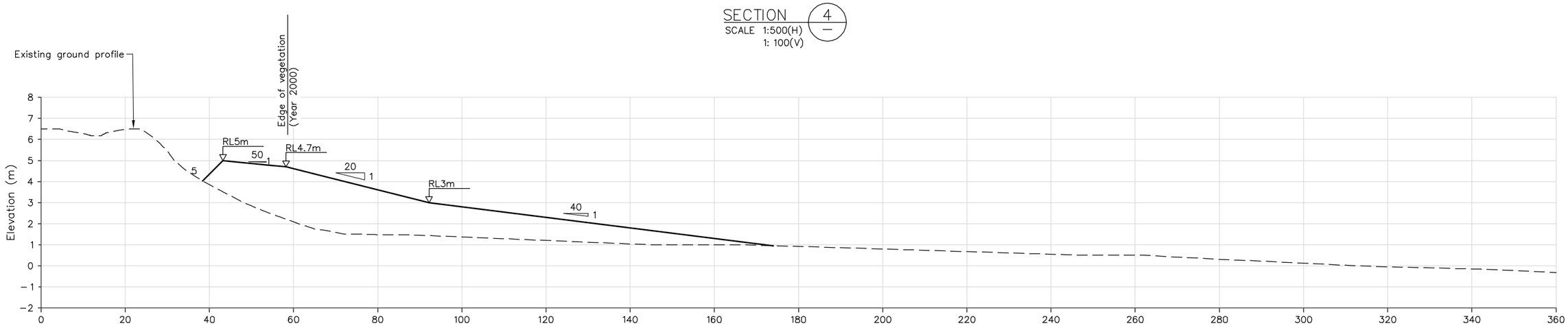
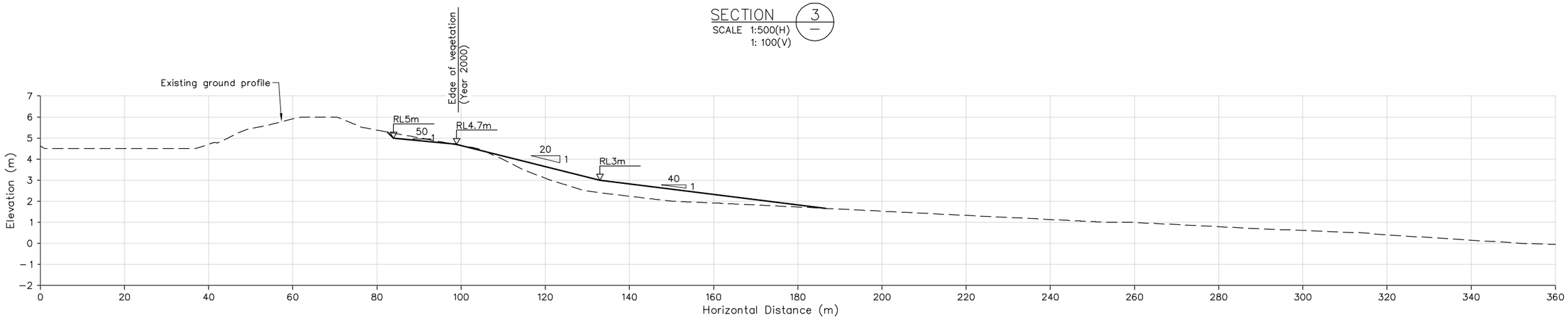


SECTION 4
SCALE 1:500(H)
1: 100(V)



SECTION 3
SCALE 1:500(H)
1: 100(V)



SECTION 2
SCALE 1:500(H)
1: 100(V)

A3 SCALE 1: 1000 (HORIZONTAL)
A1 SCALE 1: 500
0 10 20 30 40 50 (m)

A3 SCALE 1: 200 (VERTICAL)
A1 SCALE 1: 100
0 1 2 3 4 6 8 10 (m)

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TASMAN DISTRICT COUNCIL
JACKETT ISLAND
Preliminary Preferred Option
Sections (Sheet 2 of 2)

FIG. No. Figure 22

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