

# Flaxmill Bay: Beach Nourishment and Geotextile Groynes

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Summary of Monitoring Outcomes and Future Options

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*Photo: Author, November 2024*

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## Summary

This report provides an overview of the outcomes of a trial to use groynes and nourishment to provide coastal erosion protection and retain recreational beach values at Flaxmill Bay. The monitoring programme has provided a record of the distribution of sediment within Flaxmill Bay throughout the trial period. Table 1 provides a summary of actions and monitoring results over the monitoring period. Figure 1 illustrates the net change in the measured volume of each of the key areas/features over the monitoring period. The earliest monitoring record shows the state of each feature prior to construction of the groynes and beach nourishment.

Table 1: Timeline of events and monitoring outcomes at Flaxmill Bay.

Timeframe	Action/Observation
October 2020	Monitoring commenced
December 2020	Groynes constructed
December 2020	2,800 m <sup>3</sup> beach nourishment within groyne field
December 2020 - June 2021	Beach volume within groyne field reduced by approx. 40% <sup>1</sup> Erosion eastern end of reserve Loss of spit west of Flaxmill Stream Increase in area and volume of eastern beach
August 2022	Beach scraping (approx. 100 m <sup>3</sup> ) from eastern beach.
Late 2022 - Late 2023	Period of frequent storms and erosional conditions, including Cyclone Hale and Cyclone Gabrielle. Erosion of up to 10 m of eastern reserve. Continued lack of spit feature and increase in volume of eastern beach.
June 2023	Monitoring and AMP report recommending action to limit sediment trapping effect of groynes and nourishment to reduce erosion and restore spit.
August 2023	Removal of landward crest bags from central and eastern groyne. Beach nourishment adjacent to eastern reserve.
September 2024	Beach scraping (approx. 100 m <sup>3</sup> ) from eastern beach.
August 2023- April 2025	Recovery of spit area and volume. Slowed rate of coastal erosion of reserve, with some recovery due to beach scraping.
Net Change	Ongoing slow loss of beach volume within groyne field but beach volume remains higher than pre-nourishment (80% of nourished volume lost) <sup>1</sup> . Erosion of southern area of eastern beach associated with spit recovery and stream migration. Erosion of shoreline east of the eastern groyne. No significant change in total sediment volume within Bay.

<sup>1</sup> Based on reported nourishment volume of 2,800 m<sup>3</sup>.

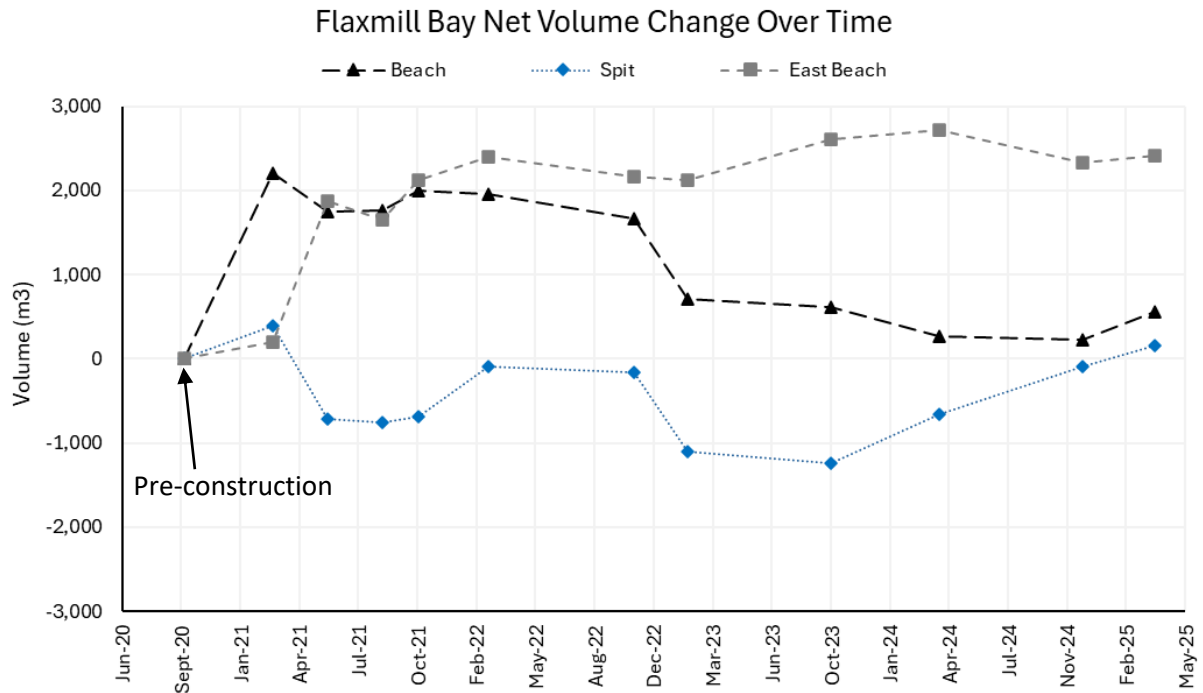


Figure 1: Changes in the volume of key morphological features over the monitoring period. Note the first data point was collected prior to construction and nourishment so figures are net change compared with the pre-construction state.

As the trial term approaches completion, monitoring outputs indicate that it will be necessary to undertake ongoing nourishment (by sediment transfer) to maintain upper beach volume and width, and to mitigate adverse effects of the groynes on beach amenity and the downdrift shoreline. Three potential options for management beyond the term of the current consents are proposed for discussion with Council and the local community:

- Option 1: Retain Status Quo, with two variations
  - o 1a - retain status quo
  - o 1b - retain status quo and additional groyne
- Option 2: Remove Groynes and Continue Nourishment and Beach Scraping, with three variations
  - o 2a - remove the groyne structures to reduce effects on sediment transport and continue to manage erosion with beach nourishment using locally sourced material
  - o 2b - remove groynes, maintain with nourishment, and retain consent to rebuild groynes if necessary
  - o 2c – remove groynes in stages to monitor shoreline response, and retain consent to rebuild groynes if necessary
- Option 3: Remove Groynes and Rock Revetment, to provide structural protection to the reserve and road with an engineered revetment.

## Background

This report summarises the outcomes of a five-year trial for erosion protection at Flaxmill Bay, Coromandel Peninsula. The project includes three geotextile groynes and an associated beach nourishment using sediment redistributed within the Bay.

The shoreline at the western end of Flaxmill Bay has historically experienced phases of erosion (approximately 7-8 m of erosion since 1970), leading to the construction of a rock revetment in fronting approximately 75 m of beach to protect the adjacent narrow reserve and Purangi Road. Ongoing erosion led to pressure for extension of the rock wall. The local community expressed a desire to retain the recreational value of the beach and installed unauthorised groyne structures with the intent to raise sand levels and prevent further erosion (4Sight, 2019).

Following further community consultation, Thames Coromandel District Council (“Council”) implemented a trial installation of three geotextile groynes with associated beach nourishment. The activities are consented under Waikato Regional Council Consents AUTH141627.01.01, 141627.02.01, 141627.03.01 and 141627.04.01 as a five-year trial. The geotextile groynes were constructed in December 2020. Sand was collected from the intertidal area within Flaxmill Bay and placed on the beach between the groynes to provide protection to the eroding bank and create a recreational beach (Figure 2, Figure 3).

This report provides a summary of the outcomes of the five-year monitoring programme and adaptive management plan and presents a range of shoreline management options for the Council and community to consider as the trial term approaches completion.



Figure 2: Flaxmill Bay with key features and areas as discussed in text.



Figure 3: Flaxmill Bay in March 2020 (left), showing unconsented groyne structures constructed by a local resident and in February 2025 showing the three consented geotextile groyne structures (right).

## Part 1: Adaptive Management Plan and Monitoring Results

The aim of the project was to investigate the effectiveness of groynes and nourishment in retaining beach sand and providing erosion protection while improving recreational amenity (as an alternative to a rock seawall). The groynes interrupt natural sediment transport alongshore and retain sand on the beach, which provides some protection against erosion of the dune. The interruption of sediment transport could adversely affect the coastal environment in other areas within Flaxmill Bay, particularly by creating a pattern of uneven sediment deposition and erosion and by exacerbating erosion downdrift (in this case east) of the structures.

The benefits and adverse effects have been measured with a monitoring programme and adaptive management plan (“AMP”) (4Sight, 2020). The plan measures ongoing changes in key geomorphic features in Flaxmill Bay, including the nourished beach, the adjacent sand spit and the beach east of the Flaxmill Stream. The monitoring also provides data to evaluate changes in the elevation and volumes of sediment in the intertidal area where nourishment sand was sourced in 2020. The AMP triggers, responses and current outcomes are attached as Appendix 1A.

Effects on coastal processes and sediment distribution were monitored with quarterly UAV surveys for the first 12 months post-construction, reduced to bi-annual frequency since. This data has allowed a detailed, quantitative analysis of changes in bed level and shoreline position, allowing assessment of sand volumes at the nourished beach and adjacent to the groynes, and changes in the area and volume of the eastern spit and beach. This data has been summarised in annual monitoring reports (Gibberd, 2022; Gibberd, 2023; Gibberd, 2024).

Monitoring outputs are assessed against triggers in the AMP to determine the need for further evaluation or management response. The triggers and responses are detailed in Appendix 1A, and include:

- exposure of the groynes and differences in beach level and width updrift and downdrift of the structures.
- area and volume of the spit east of the groynes
- volume of the intertidal bar feature
- changes in dune toe position
- area and volume of the eastern beach (east of Flaxmill Stream)
- width of the nourished beach.

The following sections provide a summary of the outcomes of the monitoring in relation the defined triggers in the AMP, and the responses that have been implemented over the monitoring period.

## Monitoring Outcomes in Relation to AMP Triggers

Results of the monitoring programme reinforce the dynamic nature of the coastline and intertidal geomorphology at Flaxmill Bay. Key geomorphic features are interconnected and constantly changing in response to environmental drivers. The net measured changes in key physical features over the monitoring period (October 2020-April 2025) include:

- gradual ongoing (but not complete) loss of nourishment material from the beach between the groynes.
- erosion of shoreline east of eastern groyne from 2021 to 2023
- loss of spit area and volume from 2021 to 2023
- recovery of the spit in 2024-2025
- fluctuations in the area and volume of the eastern beach (east of Flaxmill Stream)

It is likely that erosion of the beach, spit and dune downdrift from the groyne field between 2021 and 2023 was a response to natural cycles that redistribute sediment within Flaxmill Bay (including accumulation of sediment on the eastern beach) and a period of unusually frequent and severe storm events. Beach profile data collected by the Waikato Regional Council from eastern Coromandel beaches indicate that coastal erosion in 2023 approached or exceeded that observed since records began in the late 1970s at many sites. The erosion at the eastern section of the reserve at Flaxmill Bay was almost certainly further exacerbated by the sediment trapping effect of the groynes. Removal of bags from the central and eastern groynes appears to have helped to reestablish sediment transport along the upper beach and at least partially mitigate this effect.

The spit feature has recovered in 2024 and early 2025, and ongoing erosion of the dune has slowed. While recovery of the spit has been relatively rapid, accretion of the dune on the eastern reserve is will be a slower process. The remaining groyne structures continue to influence sediment transport patterns and may still influence shoreline recovery of the eastern reserve.

Monitoring results indicate that beach volume is low and triggers for repeat nourishment have been exceeded. Ongoing beach nourishment will be necessary maintain shoreline protection and amenity and mitigate adverse effects of the groynes and natural erosive processes.

The following sections provide a more detailed description of the outcomes of the monitoring programme and describe observed changes to each of the key geomorphic features. A range of potential management options are outlined in Part Two: Options for Ongoing Management of Coastal Erosion Hazard.

### Horizontal Offset Adjacent to Groynes

*Trigger: horizontal offset of more than 5 m comparing updrift/down drift shoreline.*

Net eastwards longshore sediment transport causes sand to accumulate against the western side of the groynes, generating a horizontal offset in beach width and a vertical offset in the level of the intertidal beach. The horizontal offset of the high-water mark adjacent to the groynes increased over time following construction, to up to 10 m in early 2023 adjacent to the eastern groyne (where the offset is greatest). In response to the exceedance of this and other triggers, the Council removed the two landward bags of the top layer of the central and eastern groynes in August 2023. The Council also undertook small scale nourishment of the upper beach and dune face with locally sourced sand. This provided for increased longshore sediment transport on the upper beach and supplemented the upper beach and dune face. Monitoring results indicate that this has slightly mitigated the horizontal offset of the upper beach (8-9 m in April 2025) (Figure 4).

This trigger is therefore exceeded if applied to the offset of beach width at the approximate high-water level. The horizontal offset in the dune line is more difficult to define quantitatively, but there is a change in shoreline orientation due to past erosion of the dune east of the eastern groyne (Figure 4). The notable increase in shoreline erosion east of the groyne field further supports the conclusion that this trigger has been exceeded. As shoreline recovery occurs relatively slowly, more time will be required to determine with certainty whether the adjustment made to the groyne structure has sufficiently mitigated the effect on the adjacent shoreline.



Beach offset at eastern groyne, April 2025. Data and imagery sourced from Thames Coromandel District Council.

0 10 20 30 m

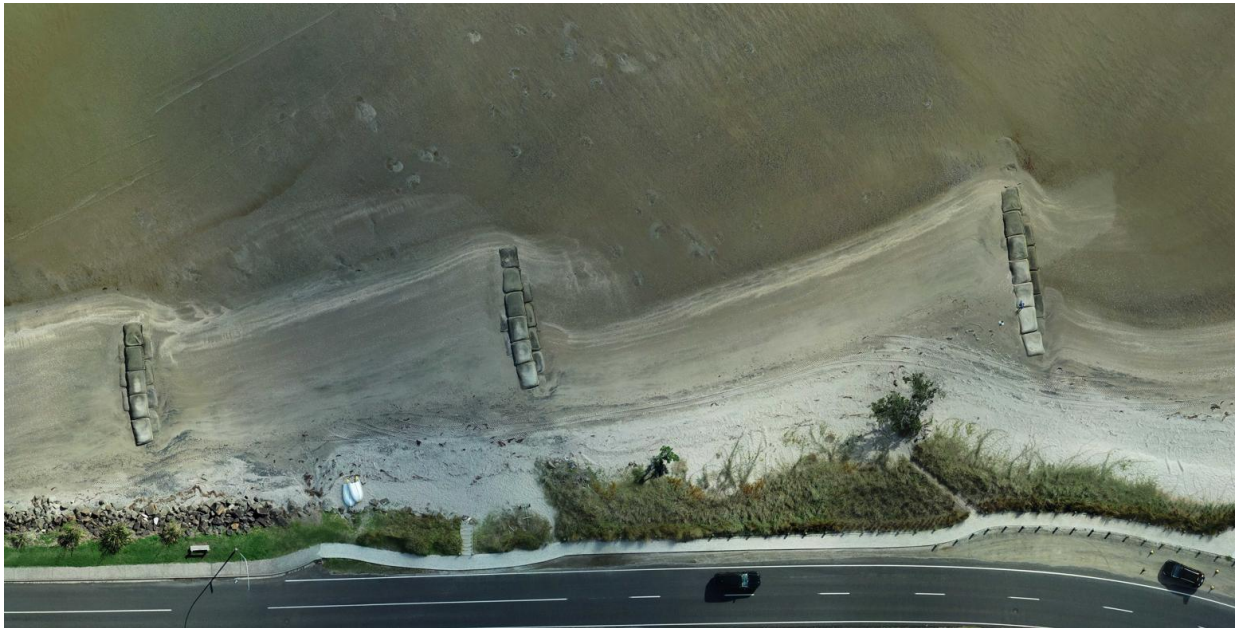


Figure 4: Horizontal offset in the 0.8 m contour (approximately MHWS) in April 2025.

## Exposure of Groynes

*Trigger: exposure exceeding the two most seaward bags on the groyne, with a maximum exposed depth of 0.6 m*

The defined trigger for exposure of the groynes has been consistently exceeded since soon after construction, and exposure of the structure will continue to increase with a loss of nourished beach volume. In April 2025, the geotextile bags are exposed along the full length of the crest, and the second layer of bags is exposed along much of the length of the groynes on the downdrift (eastern) side (Figure 5). At the western and central groynes, the upper face of some bags in the second layer are exposed on the updrift side.



*Figure 5: Exposure of the groynes in April 2025. The crests are exposed along the full length of the structures, and the second layer of geotextile bags are exposed on the downdrift (eastern) side of all three groynes, and on the updrift side of the western and central groynes.*

Sediment accumulation against the structure has created a vertical difference between the updrift and downdrift intertidal beach level, which has been exacerbated by a significant drop in beach level since construction, particularly downdrift of the structures (Figure 6). A vertical offset of 0.7 m was measured in April 2025, which is a small reduction since February 2023, when there was a vertical offset of up to 0.9 m. The periodic occurrence of localised depressions near the seaward end of the groynes also indicates that turbulence from wave action may exacerbate erosion adjacent to the structure.

The trigger relating to the exposure of the seaward bags is likely to be frequently exceeded. The groynes will not influence sediment transport on the beach until the crest is at or above the bed level. Buried groynes are not actively influencing sediment transport on the beach. As groynes intercept sediment transport alongshore, at least the downdrift side of the groynes is likely to remain consistently exposed.

Nourishment activities have targeted the upper beach and dune and have not reduced the exposure of the groynes or the vertical offset. While some exposure is inevitable, the spatial extent and depth to which the groynes are exposed could be significantly reduced with more frequent and extensive beach nourishment. This mitigation is identified in the adaptation plan. With ongoing longshore sediment transport to the east, the structures will become gradually exposed after a nourishment, particularly on the downdrift (eastern) side.

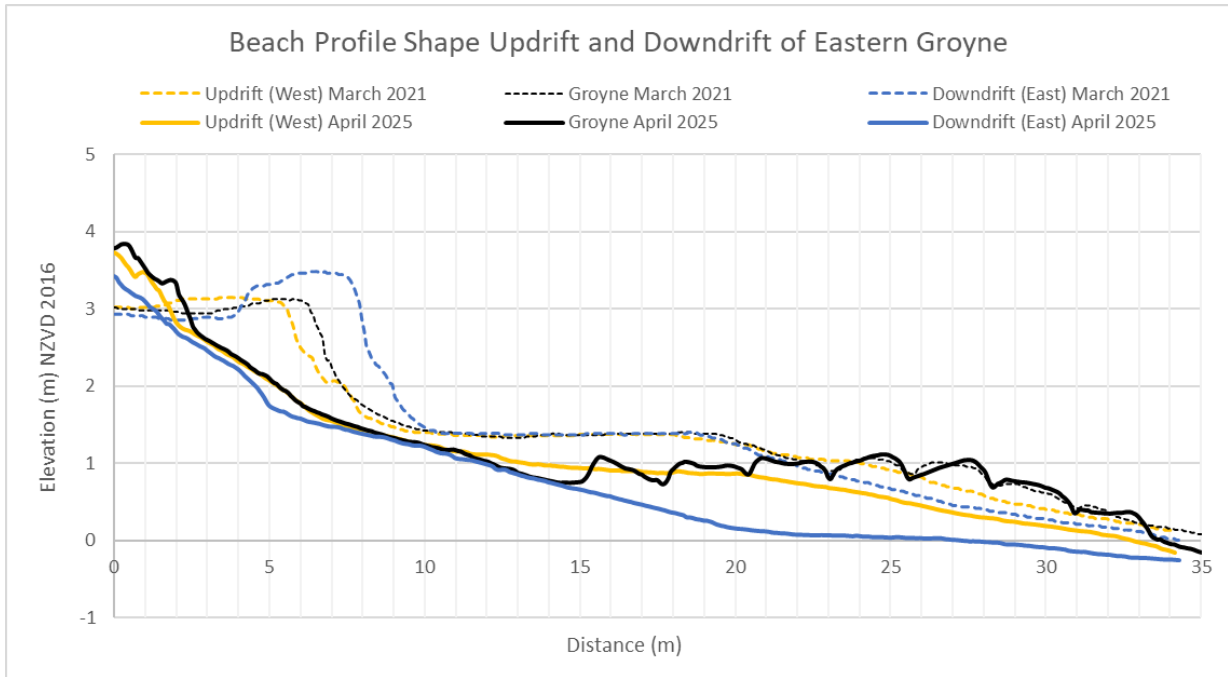


Figure 6: Differences in beach cross section immediately adjacent to the updrift (western) and downdrift (eastern) side of the eastern groyne in March 2021 (soon after construction) and April 2025. Figure also shows change in upper groyne due to removal of upper bags. Note beach lowering has been significantly greater downdrift of the groyne compared with the beach updrift.

#### Change to the Inlet Spit Feature

*Trigger: erosion exceeding 20% of the spatial extent or spit volume (evaluate cause), further trigger for intervention erosion exceeding 30% of spatial extent.*

The volume and area of the spit was greatly reduced in the first two years following the construction of the groynes (Figure 7). This change exceeded the defined triggers for further intervention. In accordance with the AMP, two landward bags of the top layer of the central and eastern groynes were removed in August 2023 (supported by small scale nourishment). Monitoring data from October 2023 showed some loss of sediment from the beach adjacent to the central groyne but little immediate response to this in terms of recovery of the beach and spit. Data collected since April 2024 shows minor ongoing loss of beach area and volume, and a rapid and ongoing increase in spit area and volume (Figure 8). The spit volume is now similar to that measured prior to construction of the groynes (Table 4), though the spatial extent of the spit feature is further landward (Figure 10).

These outcomes suggest that lowering of the groyne crests has improved sediment supply to the spit, but data also suggests that mobilisation of sediment from the beach within the groyne field has been insufficient to supply the observed recovery (Figure 1, Table 4). Over the same period, there has been significant eastwards migration of the stream entrance and erosion of the south section of the eastern beach (Figure 8), which may also have contributed to spit recovery.

The historical aerial photography record indicates that the sand spit is naturally a very dynamic feature, linked to patterns in local sediment supply and fluctuations in the orientation of the stream outlet. These fluctuations and the interactions between the spit, stream and eastern beach were described in 4Sight (2019) and have been observed throughout the monitoring period. While the data presented here indicates that the groynes were interrupting sediment supply and exacerbating loss of spit volume, it is reasonable to expect that the spit will continue to fluctuate significantly in volume and extent in the future regardless of the chosen management approach.

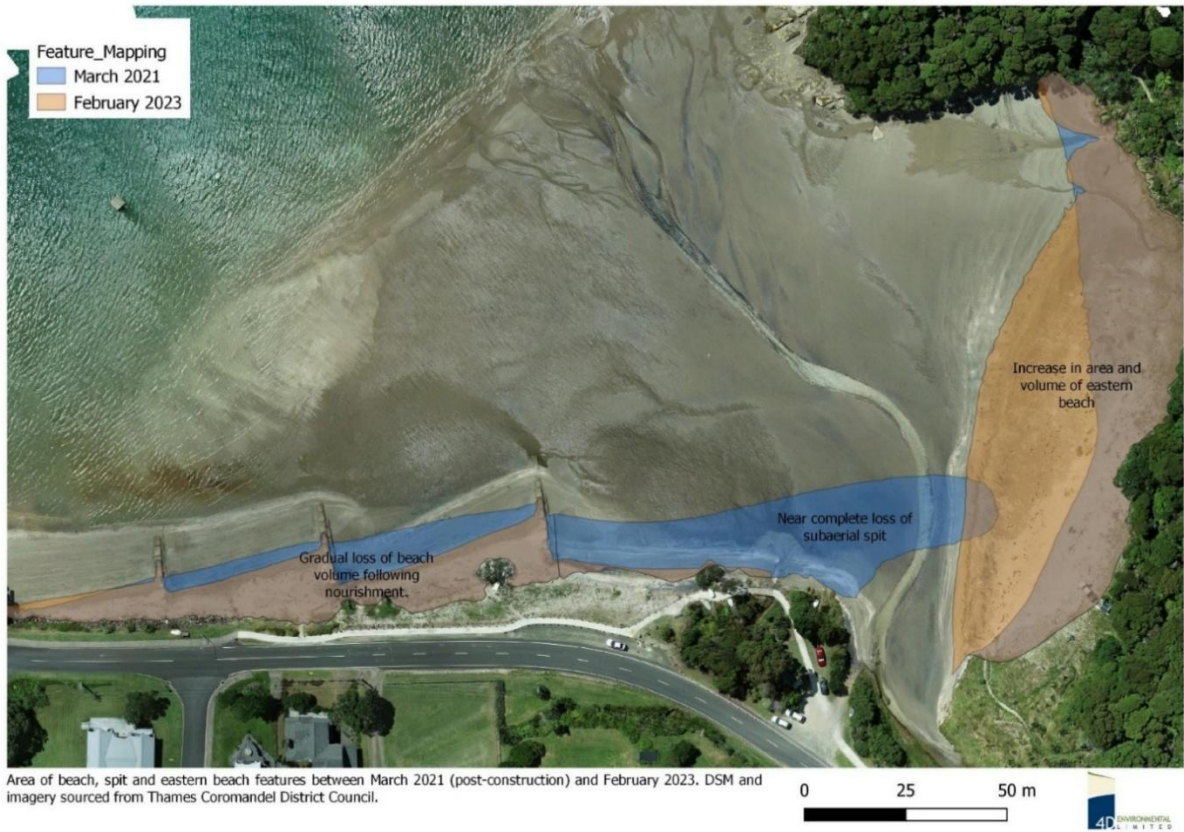


Figure 7: Changes in the aerial extent of the beach, spit and eastern beach following nourishment (March 2021-February 2023).



Figure 8: Changes in the aerial extent of the beach, spit and eastern beach February 2023-April 2025 (since removal of upper bags on central and eastern groyne).

This trigger was exceeded during the monitoring period, and subsequent recovery of the spit following adjustment of the groyne structure means the trigger is no longer exceeded. Irrespective of the chosen management option, natural fluctuations may occur in the future that exceed the defined trigger, suggesting that the value of this trigger as currently defined is in question.

#### Intertidal Bar

*Trigger: Loss of intertidal bar formation for a period of 12 months following construction.*

The AMP identifies a trigger relating to sustained loss of the intertidal bar. The bar feature was clearly visible in aerial images from March 2021 (post-construction). Subsequent monitoring data indicates that a clearly defined intertidal “bar” is a transient feature. Sediment distribution in the intertidal areas of the bay is highly variable. The feature is visible in monitoring data collected in December 2024 indicates that the feature continues to form under certain conditions.

As noted in earlier monitoring reports (e.g. Gibberd, 2024), historical aerial photography and monitoring data suggests that given the ephemeral nature of the offshore bar feature, it is not practical to define the extent of the “bar” or report volume changes and determine the exceedance of trigger values in terms of a monitored effect of the nourishment and groynes. This feature has not therefore been applied as a trigger over the monitoring period.

The monitoring data has recorded fluctuations and net changes in the levels and volume throughout the Bay (Appendix 1B) but no meaningful change in overall volume of the wider intertidal area, including the area of sediment extraction.

#### Eastern Pocket Beach

*Trigger: erosion exceeding 20% of the spatial extent (evaluate cause), further trigger for intervention erosion exceeding 30% of spatial extent.*

The volume of the pocket beach east of Flaxmill Stream has fluctuated over the trial period. The volume of the eastern beach increased between 2020 and 2023, which coincided with loss of the shoreline and spit fronting the reserve (Figure 7). The total increase in volume of the eastern beach and intertidal zone over this time was equivalent to the volume lost from the nourished beach and spit (Figure 8). The southern portion of the eastern beach has significantly eroded since 2023, and this has coincided with an increase in the extent and volume of the eastern spit feature and eastwards migration of the Flaxmill Stream (Figure 8). Drivers for these changes are likely to include changes in wave energy and direction during storm event, water level fluctuations and changes in stream discharge (including frequency of heavy rainfall events). The overall (net) change in beach area and volume since the beginning of the project is relatively small in relation to the scale of fluctuations.

Historical data suggests that this feature is very dynamic, and that fluctuations in the beach width and changes in the eastern spit are interconnected. The current triggers may therefore be too sensitive, as natural fluctuations may occur in the future that exceed the defined trigger regardless of the management approach adopted. Changes in the area and volume of the eastern beach should be carefully interpreted, and the trigger may be of limited value.

## Shoreline Erosion

*Trigger: 2 m of erosion of dune (evaluation), 4 m of dune erosion (response sand transfer and adjustment of groyne)*

The monitoring data indicates that the groynes and nourished beach (supplemented by small-scale maintenance nourishment and beach scraping) has prevented ongoing erosion of the shoreline within the groyne field (i.e. west of the eastern groyne). There has, however been loss of beach volume and severe erosion (over 10 m in some places) of the unprotected shoreline adjacent to and (most significantly) east of the eastern groyne between 2021 and 2023 (Figure 9). This erosion occurred as the shoreline became exposed following loss of the beach and spit feature and has been more severe than any erosion observed from historical aerial photography.

Small scale beach nourishments have been completed on two occasions to aid beach and dune recovery following erosion events (in addition to the August 2023 works):

- August 2022: small scale beach push-up east of the eastern groyne (approximately 100 m<sup>3</sup>).
- September 2024: approximately 100 m<sup>3</sup> placed at toe of eroded dune east of eastern most groyne and central groyne (no sand placed on the beach).



Figure 9: Change in dune toe position over monitoring period. Note severe erosion adjacent to and east of the eastern groyne.

It is likely that the groynes exacerbated erosion downdrift of the eastern groyne by restricting sediment transport to the eastern portion of the reserve and to the spit area. Although this impact has been mitigated by alterations made to the groynes, these structures will continue to have some ongoing influence on the sediment supply to the area. There is insufficient data to determine whether the adjustment made to the groyne structure has sufficiently mitigated the effect on the adjacent shoreline to allow ongoing shoreline recovery.

## High Tide Beach

*Trigger: erosion reducing high tide beach to less than 5 m (initiate nourishment), further trigger for action at beach width less than 3 m.*

There has been ongoing gradual loss of beach volume and width over the five-year trial. Data from April 2025 indicates approximately 80% of the sediment that was added to the beach has been lost. The most significant loss of volume occurred between November 2022 and February 2023. This gradual loss and the requirement for maintenance is expected in any nourishment project.

A high tide beach of at least five metres remained in most areas until 2024, at least in part due to beach scraping/nourishment efforts. The most recent data indicates the beach width is less than five metres in some areas and the trigger for maintenance nourishment has now been exceeded within the groyne field. Data indicates that there is still three metres of high tide beach in most areas.

## Appendix 1A: Adaptive Management Triggers – Summary

Table 2: Adaptive management triggers for future management responses. This table does not include triggers for the benthic ecology monitoring programme.

Trigger Exceeded		Trigger Not Exceeded		
Observed Change	Trigger for Initial Management Response	Initial Management Response	Trigger for Further Intervention	Further Management Response
Shoreline offset up/down drift of groynes	Horizontal shoreline offset of more than 5m comparing up/down drift	Remove geotube(s) to create weir feature to allow increased bypassing *Completed August 2023	Persistent horizontal shoreline offset of more than 5m comparing up/down drift	Increase size of weir or transition to detached groynes.
Visual exposure of geotextile bags	Exposure of the two most seaward bags along the crest of the groynes and/or vertical exposure of more than 60cm	Undertake minor nourishment activity to cover the exposed bags	Exposure of more than the two most seaward bags along the crest of the groynes (e.g. storm related)	Undertake survey to assess the quantity of sand required to replenish beach areas and undertake monitoring and physical works accordingly.
Significant changes to inlet spit feature	Erosion exceeding 20% of the spatial extent or spit volume (no trigger if erosion is due to spit shearing during high flow from stream)	Evaluate monitoring data for causal link to groyne installation	Erosion exceeding 30% of the spatial extent (no trigger if erosion is due to spit shearing during high flow from stream)	Increase bypassing of easternmost groyne via shortening and/or lowering *Completed August 2023, trigger no longer exceeded.
Significant changes to bar feature (Post-Construction) <b>**difficult to quantify</b>	Loss of intertidal bar formation for a period of 12 months following construction	Evaluation of monitoring data to establish links. Temporary halting of sand shifting from intertidal area until bar recovers	Loss of intertidal bar formation for a period of 36 months	Continued halting of sand shifting from intertidal area until bar recovers. Investigation of causal links between bar recovery and groyne placement and potential benefits of removal
Impact on the spit dune feature	2m erosion of dune feature	Evaluation of monitoring data to establish causal links and evaluate need to adjust eastern most groyne to encourage sand bypassing	4m erosion of dune feature	Initiating sand transfer to re-establish dune feature (from annual top up allowance of 600m <sup>3</sup> ) and adjust eastern groyne design. *Ongoing beach scraping works.
Significant reduction to eastern pocket beach	Erosion exceeding 20% of the spatial extent	Evaluate if beach is equilibrating or groyne requires additional bypassing – reduce volume or frequency of sand extraction or shorten eastern-most groyne	Erosion exceeding 30% of the spatial extent	Evaluate if bar is equilibrating or groyne requires additional bypassing – temporary halting of sand shifting until beach recovers or increase bypassing of easternmost groyne via shortening and/or lowering
Significant reduction of high tide beach	Erosion reducing high tide beach width to < 5m	Initiate maintenance nourishment. *Nourishment and beach scraping undertaken.	Erosion reducing high tide beach width to 3m	Undertake scraping and nourishment and consider the effectiveness of groyne design against coastal processes data for potential future works beyond trial period

## Appendix 1B: Area Changes

Table 3: Spatial extent of key physical features, net change in area since pre-project conditions, and change since the completion of the groynes and nourishment.

Date	Area (m <sup>2</sup> )		
	Beach	Spit	East Beach
October 2020	584	1,272	3,394
March 2021	1,880	1,839	2,623
June 2021	1,615	400	4,616
September 2021	1,902	374	4,879
November 2021	1,944	490	5,015
March 2022	1,861	1,498	4,727
November 2022	1,666	1,154	4,467
February 2023	1,364	88	4,881
October 2023	1,231	535	4,674
April 2024	1,125	1,760	4,685
December 2024	*	2,799	3,229
April 2025	1,046	3,306	2,683
Net change pre-nourishment - present (Oct-2020 to Apr-2025)	+462	+2,034	-711
Net Change post-nourishment and construction (Mar-2021 to Apr-2024)	-834	+1,467	+60
% Change post-nourishment**	-44%	+80%	+2%

\*area not fully covered by survey

Table 4: Changes in volume of features within Flaxmill Bay over the monitoring period.

Date	Volume (m <sup>3</sup> )		
	Beach	Spit	East Beach
October 2020	2,304	2,187	8,136
March 2021	4,507	2,579	8,331
June 2021	4,048	1,471	10,015
September 2021	4,071	1,437	9,788
November 2021	4,309	1,503	10,257
March 2022	4,267	2,097	10,542
November 2022	3,975	2,027	10,294
February 2023	3,009	1,092	10,261
October 2023	2,925	943	10,739
April 2024	2,572	1,534	10,851
December 2024	2,530	2,100	10,466
April 2025	2,869	2,341	10,552
Net change pre-nourishment - present (Oct-2020 to Apr-2025)	+565	+154*	+2,416
Net Change post-nourishment and construction (Mar-2021 to Apr-2024)	-1,638	-1,045	2,520
% Change post-nourishment**	-36%	-41%	+30%

\*Spit volume has recovered defined as the volume of sediment above 0.0 m RL that forms the geomorphic feature. The spatial footprint of the feature is significantly further landward than prior to commencement of the trial.

\*\*Loss of total beach volume above 0.0 m RL. Loss of added beach nourishment volume is approximately 80%, based on a reported nourishment volume of 2,800 m<sup>3</sup>.

## Appendix 1C: Net Morphological Change Figures





Changes in the aerial extent of the beach, spit and eastern beach between October 2020 and April 2025. DSM and imagery sourced from Thames Coromandel District Council.

Figure 10: Changes in the aerial extent of the beach, spit and eastern beach between-October 2020 (pre-construction), March 2021 (post-construction) and April 2025.



Changes in sediment level between March 2021 and April 2025. DSM and imagery sourced from Thames Coromandel District Council.

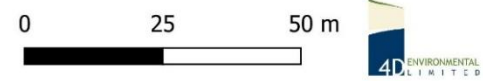


Figure 11: Changes in sediment level between March 2021 (first dataset post-nourishment) and April 2025. Red areas indicate sediment accretion while blue and green areas show lowering of the sediment surface. Yellow areas suggest little or no change.



## Appendix 1D: Changes in Sediment Distribution 2020-2025



Figure 12: Changes in sediment distribution and shoreline position from pre-construction (top – October 2020), post construction (middle – March 2021) and most recent (bottom – April 2025).

## Part 2: Options for Ongoing Management of Coastal Erosion Hazard

Resource consent for the groynes and beach nourishment trial expires in October 2026. If Council wishes to retain consent for the activity beyond this time, an application for Resource Consent needs to be submitted in April 2026. Three options are presented here for consideration and discussion. These approaches reflect the local coastal management objectives and the outcomes of the trial. Costs are outlined in Appendix 2A.

### Option 1: Retain Status

#### Option 1a: Retain Status Quo

Apply for extension of the existing resource consent term to retain the three geotextile groyne structures and to provide for periodic beach nourishment of up to 600 m<sup>3</sup> per year using material from the intertidal bar or eastern beach. Ongoing beach nourishment and/or beach scraping will be necessary to maintain beach volume and prevent loss of the beach and retreat of the shoreline. Monitoring data indicates that the rate of sediment loss from the beach within the groyne field varies over time, generally in the order of 500-1,000 m<sup>3</sup>/yr. It may not be necessary to retain the beach nourishment consent if Council feels that the existing beach scraping consent provides sufficiently for these activities.

#### Option 1b: Retain Status Quo + Additional Groyne

Council would apply for an extension of the existing resource consent term to retain the three geotextile groyne structures and seek consent to construct an additional groyne to stabilise the eastern section of the beach fronting the reserve. This approach would also require initial nourishment to “fill” the groyne with sediment to limit downdrift effects. Periodic beach nourishment of up to 600 m<sup>3</sup> per year could continue using material from the intertidal bar or eastern beach.

### Benefits

Option 1a and 1b provide a means to retain beach volume due to the sand trapping action of the groynes on the intertidal beach. The maintenance of a beach provides protection to the reserve from coastal erosion. An additional groyne could extend these benefits alongshore and would increase the level of protection to the reserve shoreline. With sufficient beach nourishment, the width of the beach can be retained for recreation and erosion protection purposes.

### Possible Adverse Effects

Groynes restrict eastwards sediment transport along the beach and can therefore exacerbate beach and dune erosion east of the groyne field as observed during the trial period. This effect was mitigated by shortening and lowering the central and eastern groynes in 2023. Construction of an additional (fourth) groyne could cause a similar sediment deficit further east if not carefully designed and managed. This could exacerbate loss of the spit and associated ecological values. There will be an ongoing visual impact and a vertical “step” in the beach updrift and downdrift of each groyne.

The location and design of a fourth groyne would need to provide for potential undermining on the western side during periods of stream migration and would also need to consider interaction with the stormwater outlet. Repeated periodic beach nourishment is required to mitigate this effect.

The existing geotextile bags are showing some evidence of deterioration, with microfibres (plastics) being found along the shoreline. Communication with the manufacturer (Geofabrics) has highlighted that the current bags are pre-2019 and have more likelihood of UV and environmental degradation than the equivalent more recently constructed product. After 2019, there were significant improvements to

the fibres UV and environmental stability construction. If keeping the bags remains an option, then either a partial or full replacement of the bags (all three groynes) will be required.

#### Risks

A key risk of Option 1a is ongoing erosion of the eastern reserve, which over time could threaten the footpath, public toilet and boat ramp. The construction of an additional groyne under Option 1b could impact on stream flow and could result in a loss of ecological values.

A long-term commitment to the use of groynes is a financial commitment by the Council. Groynes could be damaged and require removal or replacement.

#### Related Costs

Option 1a requires a renewal of (and possible change to) the existing resource consent. Option 1b would require further analysis of coastal processes and the likely impact of the structure on sediment transport, erosion, ecology and landscape/natural character. There would be ongoing monitoring requirements to investigate effects on local coastal processes. Option 1a and 1b include construction costs associated with either partial or full replacement of existing bags, and the additional groyne.

#### Option 2: Remove Groynes

Option 2 involves removal of the groynes and continued beach nourishment and beach scraping to maintain the beach volume and width to retain amenity and prevent erosion. Variations of this approach are described below as Option 2a–2c.

##### Option 2a: Remove Groynes + Continue Nourishment and Beach Scraping

Council would remove the three existing groynes and manage the erosion with beach nourishment and beach scraping only.

##### Option 2b: Remove Groynes + Continue Nourishment + Retain Consents to Rebuild

This option would include removal of the groynes, but also renewal of the resource consent to provide for rapid reinstatement of the groynes should it be proven necessary. This would allow Council to investigate the feasibility of maintaining beach width and coastal erosion protection with beach nourishment and/or beach scraping, while retaining the option to replace the groynes. This would involve applying to keep the consent, but with a likely five-year timeframe to allow for reestablishment of the structures if required.

##### Option 2c: Remove Groynes in Stages + Continue Nourishment + Retain Consents to Rebuild

This option would provide a compromise by removing the groynes in stages to monitor shoreline response. This option includes removal of just the top layer of one or all the groyne structures to allow increased sediment transport along the beach. Over time the structures may be removed completely in a staged manner.

#### Benefits:

Removal of the groynes would restore natural sediment transport along the beach to the eastern reserve and sand spit, and in time develop a shoreline that better reflects the local processes. This option would remove the visual impact and the horizontal and vertical offsets in beach level caused by the groynes. This approach also avoids the ongoing threat to the spit due to interruption of sediment supply and therefore supports the retention of bird habitat (dotterels), as it is expected that the spit will remain in place for longer periods. With the removal of structures from the coastal marine area, the resource consent would no longer be required.

These benefits would be achieved in the short term with Option 2a and 2b, or gradually over time with Option 2c. Option 2c allows for a more cautious approach by providing time for monitoring of the shoreline response to removal of the groynes.

Option 2c allows adequate planning time to budget for and purchase new geotextile bags (some of the existing bags may require replacement within the next five years).

#### Possible Adverse Effects

The beach and shoreline would undergo an initial adjustment following removal of the groynes as sediment is redistributed along the beach. This adjustment could result in dune erosion if sufficient sediment is not available on the beach. To avoid this, beach nourishment should be undertaken at the same time as removal of the groynes. Under Option 2c, this response would be more gradual/staged. By undertaking a staged removal of the structures, there would be less risk of sudden erosion associated with adjustment of the shoreline.

Monitoring results indicate an ongoing loss of beach volume over the monitoring period. The beach along western areas of the road reserve may be more susceptible to erosion without the sand retaining action of the groynes. The rate of sediment loss will vary depending on local conditions and natural cycles of sediment transport within the Bay. It is likely that the volume and frequency of nourishment required to provide coastal amenity and erosion protection may increase following removal of the groynes.

#### Risks

A risk associated with this option is the short-term response to removal of the structures and subsequent adjustment of the beach and shoreline. It may be more difficult to maintain adequate beach volumes, particularly along western and central areas of the reserve. There is a risk that the reserve may be impacted by coastal erosion if sufficient beach nourishment is not achieved and the beach amenity could be degraded. Option 2a and 2c require renewal of the resource consent but provide for rapid reinstatement of the structures if proven necessary.

A brief assessment from Geofabrics to review the structural integrity of the existing bags would be required prior to reinstatement and it would be likely that some or all bags would need to be replaced.

#### Related costs

The cost of sand transfer and beach nourishment may be greater than with other options presented here, with anticipated 1-4 works per year. There will be no consenting or monitoring costs associated with the structures if they are removed. Option 2b and 2c will require renewal of existing consents and would require some ongoing monitoring.

There would be a one-off cost to removing and disposing of the groynes and additional costs of re-construction of the groynes if deemed necessary. This is a relatively expensive option due to consenting costs, increased requirement for beach nourishment and the cost of removing the groynes. An additional cost would be incurred if it were necessary to rebuild the groynes.

#### Option 3: Remove Groynes + Rock Revetment

This option would provide structural protection to the reserve and road with an engineered revetment. The Council previously held consent for extension of the existing rock revetment.

#### Benefits

This approach would provide greater certainty of protection to the road, infrastructure and reserve than reliance on beach nourishment.

### Possible Adverse Effects

Reliance on engineered protection of the shoreline would have a range of adverse effects. During periods of erosion (and in the future with sea level rise), the sandy beach is likely to be lost. This would impact on public access along the coastal marine area and have a major impact on use of the beach.

### Risks

It is possible that the Council would not obtain resource consent to construct a rock revetment due to the potential adverse effects of a hard protection structure. Construction of the revetment could result in loss of amenity value of the local environment, impacting significantly on the use of the coast by residents and visitors.

### Related costs

If the existing consent is no longer able to be implemented, a new consent process would need to be initiated. A hard protection structure in the coastal marine area would require resource consent as a discretionary activity under the Waikato Regional Coastal Plan.

The construction cost a revetment like the structure currently protecting the road at the western end of the beach would be considerable. This would be the most expensive option.

## References:

4Sight, 2019: Flaxmill Bay Groynes Coastal Processes Impact Assessment. For Thames Coromandel District Council, December 2019. AA5723\_Flaxmill Bay Groyne Coastal Processes Assessment\_v.01. 9p.

4Sight Consulting, 2020: Flaxmill Bay Adaptive Management Plan V5.0. Prepared for the Thames Coromandel District Council, November 2020. 15p.

Gibberd, 2022: Monitoring Report – Flaxmill Bay, Beach Nourishment and Geotextile Groynes. Prepared by 4D Environmental for Thames Coromandel District Council. April 2022, 24p.

Gibberd, B. 2023: Monitoring Report – 2022-2023. Beach Nourishment and Geotextile Groynes. April 2023. Prepared by 4D Environmental for Thames Coromandel District Council. April 2023, 15p.

Gibberd, B. 2024: Monitoring Report – 2024. Beach Nourishment and Geotextile Groynes. Prepared by 4D Environmental for Thames Coromandel District Council. June 2024, 15p.

## Appendix 2A: Cost Estimates

OPTION	NEW CONSENTING/CONSTRUCTION COSTS	ANNUAL CONSENT FEES	ANNUAL MONITORING COSTS	ANNUAL REPORTING COSTS	ANNUAL MAINTENANCE COSTS	TOTAL ANNUAL COSTS	TOTAL NEW COSTS	NOTES	
<b>1.A RETAIN STATUS QUO</b>	\$ 5,000.00 WRC	\$ 1,500.00	\$ - DRONE \$ - ECOLOGY	\$ - \$ -		\$ 5,000.00 \$ 6,500.00	\$ 11,500.00	Assuming no additional monitoring required (as per AMP). Assumed 2 nourishment events per year plus any bags maintenance. Some/all bags may require replacement of bags within next 5 years. May require monitoring at additional costs	
<b>1.B RETAIN STATUS QUO + ADDITIONAL GROUYNE</b>	\$ 5,000.00 WRC	\$ 1,500.00	\$ 5,000.00 DRONE	\$ 4,000.00 DRONE		\$ 5,000.00	\$ 29,500.00	\$ 61,500.00	Assuming new round of monitoring due to new groyne. Assumed 2 nourishment events per year plus any bags maintenance. Add \$60,000 for additional groyne in future years (\$15,000 for new bags, remaining construction costs). Assumed reporting for 3 years minimum
	\$ 5,000.00 COASTAL PROCESSES \$ 10,000.00 ECOLOGY \$ 12,000.00 PLANNING		\$ 10,000.00 ECOLOGY	\$ 4,000.00 ECOLOGY					
<b>2.A REMOVE GROYNES AND CONTINUED NOURISHMENT (NO CONSENT)</b>	\$ 60,000.00 ADDITIONAL GROUYNE CONSTRUCTION						\$ 121,500.00		
	\$ 15,000.00 GROUYNE REMOVAL	\$ -	\$ -	\$ -		\$ 10,000.00	\$ 10,000.00	\$ 25,000.00	Assumed 4 nourishment events per year
<b>2.B REMOVE GROYNES AND CONTINUED NOURISHMENT (KEEP CONSENT)</b>	\$ 5,000.00 WRC	\$ 1,500.00	\$ -	\$ -		\$ 10,000.00	\$ 11,500.00	\$ 31,500.00	Assumed same costs for new consent. Assumed 4 nourishment events per year
	\$ 15,000.00 GROUYNE REMOVAL								
<b>2.C REMOVE GROYNES IN STAGES + AMEND CONSENT</b>	\$ 180,000.00 NEW GROUYNE CONSTRUCTION							\$ 211,500.00	Add \$200,000 to reinstate 3 groynes, \$15,000 per groyne for bags, remaining is construction. Some/all bags may require replacement within next 2-5 years.
	\$ 5,000.00 WRC	\$ 1,500.00	\$ -	\$ -		\$ 10,000.00	\$ 11,500.00	\$ 31,500.00	Assumed same costs for new consent. Assumed 4 nourishment events per year. Groyne removal costs likely split due to staged removal
<b>3. REMOVE GROYNES + NEW SEAWALL</b>	\$ 15,000.00 WRC	\$ 1,500.00	\$ 4,000.00 DRONE	\$ 4,000.00 DRONE		\$ 1,000.00	\$ 24,500.00	\$ 613,000.00	Assumed reporting for 3 years minimum  Costs may be higher depending on level of complexity of consent application  Does not include consultation or other unknown costs
	\$ 15,000.00 GROUYNE REMOVAL SEAWALL		\$ 10,000.00 ECOLOGY	\$ 4,000.00 ECOLOGY					
	\$ 500,000.00 CONSTRUCTION (100m)								
	\$ 15,000.00 TCDC								
	\$ 5,000.00 COASTAL PROCESSES								
	\$ 15,000.00 ECOLOGY \$ 25,000.00 PLANNING								

