

Buffalo Beach Coastal Erosion Management Strategy : Part 1 - Strategy

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▪ report

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1 Introduction and Background to Project

Introduction

Environment Waikato (EW) and Thames Coromandel District Council (TCDC) have identified coastal erosion as being a significant hazard risk to Coromandel properties¹. Projected sea level rise over the next 100 years is estimated to lead to another 15-20 metres of erosion along beaches on the eastern Coromandel, putting approximately 920 properties at risk².

Approximately 920 Coromandel peninsula properties, with an estimated market value of almost \$1 billion, may be affected by coastal erosion within the next 100 years.

EW and TCDC are working together to address the hazard, beginning with two priority sites – Buffalo and eastern Cooks Beach. The Beca led team (with Eco Nomos Ltd and Covec as subconsultants) have been commissioned by the two authorities to identify issues and options at the sites and select the most technically feasible and cost effective mitigation option. The draft strategy produced by the project team will be used as part of a wider consultation programme with the community and other stakeholders to ultimately select a preferred coastal erosion strategy for Buffalo Beach that promotes sustainable management of the coastal area (see Appendix C for discussion on provisions of regional and district statutory documents that relate to sustainable management of the coast).

Part I of the Coastal Erosion Management Strategy (CEMS) should be read in conjunction with Part II – Technical Appendices to provide further details of CEMS development.



Background to Project

This site specific CEMS for Buffalo Beach lies within a wider joint Coastal Erosion project EW and TCDC are currently working on. The wider project is considering District-wide issues associated with coastal erosion. The project purpose is twofold, namely to develop a joint agency approach to managing coastal erosion hazards on the Coromandel Peninsula and to develop an associated funding system for the management of coastal erosion issues.

This site-specific project will provide information and tools to assist EW, TCDC, the community and tangata whenua in the decision-making process when addressing coastal erosion at Buffalo Beach³.

¹ Environment Waikato, 2002. Coromandel Beaches. Coastal Hazards & Development Setback Recommendations Summary Report. Environment Waikato Technical Report.

² Coastal Erosion Project Overview Strategic and Economic Components, Draft Report for Discussion, Environment Waikato Environmental Economist, June 2004..

1.1 Assumptions and Limitations of Study

- The area from Tarapatiki Stream in the north through to the area adjacent to the wharf at the southern end of the beach (Figure 2), and excludes Ohuka Beach to the northwest.
- The assessment is based around a 50-year planning horizon to incorporate sustainable development principles and future generations needs.
- For the purposes of this project no fieldwork has been undertaken and so analysis is based on existing technical information that has been provided by EW and TCDC as well as project team knowledge and experience.
- EW and TCDC will undertake community and iwi consultation as a separate project; therefore no community or stakeholder consultation has been undertaken in this strategy development. It is anticipated that the preferred option(s) will be further refined through this consultation.
- No specific design work has been undertaken therefore construction and maintenance costs are estimates for generic structures (e.g. seawall).
- A number of economic assumptions have been made. For further details see Appendix F.

2 Methodology

The Buffalo Beach Erosion Management Strategy study area has been defined by EW and TCDC as *“The area from Tarapatiki Stream in the north through to the area adjacent to the wharf at the southern end of the beach, and excludes Ohuka Beach to the northwest.”*

The Buffalo Beach strategy area has differing levels of development along the foreshore and therefore differing levels of coastal erosion hazard. It was therefore considered necessary to divide the Buffalo Beach study area into sections depending on the existing level of development/infrastructure and the level of present and future coastal erosion hazard. The divisions are shown in Figures 1a, 1b and 1c and are described as:

- 1) southern section – starts at the end of the beach adjacent to the wharf and extends north to where Halligan Road meets State Highway 25 (Figure 1a);
- 2) mid section - where there is currently no development adjacent to the shore (Figure 1b);
- 3) northern section – where there is currently residential development adjacent to the shore and extending north until the Tarapatiki Stream (Figure 1c).

³ Environment Waikato Contract 921518 Coastal Erosion Management Strategies for Cooks and Buffalo Beaches, 2004.

Figure 1 (a): Buffalo Beach Southern Section



Figure 1(b): Buffalo Beach Mid Section



Figure 1 (c): Buffalo Beach Northern Section



Although it is recognised that a management strategy would usually address the beach as a whole system, the strategy does not consider Ohuka Beach to the northeast of Tarapatiki Stream as this area is currently the subject of a beach nourishment study being conducted by Opus International Consultants.

The preferred options for each section of Buffalo Beach have been determined by considering the economic, social and environmental issues to achieve triple bottom line outcomes⁴ for the long-term sustainable development of this beach. The following approach has been used:

1. The background to the coastal erosion problem was researched, including investigations into whether there is a coastal erosion hazard at Buffalo Beach, and a draft strategy 'vision' developed.
2. A list of potential options was produced for each section of Buffalo Beach strategy area based on available literature sources, the knowledge and experience of the project team and a constraints and opportunities workshop.
3. The potential options were screened for any 'fatal flaws' that made some options technically unfeasible. Justifications were given as to why these options were not considered viable options for further assessment.
4. The options that passed the screening were then qualitatively assessed against various environmental, social and economic impact categories (multi-criteria analysis⁵) and assigned an impact grade depending on their estimated level of effects. Selection of

⁴ See Glossary in Appendix L for definition of triple bottom line outcomes.

⁵ See Glossary in Appendix L for definition of multi-criteria analysis

impact categories was based on previous research undertaken by EW on sustainable development criteria used in international studies.

5. Each option was quantitatively assessed using cost-benefit analysis techniques to measure the overall well-being (or welfare) impacts of the different options for coastal management and macro-economic techniques to measure impacts on the size of the local economy.
6. A number of preferred coastal erosion management options were identified for each section of Buffalo Beach using an evaluation matrix and the results of the economic analysis. These options are considered the most likely to achieve the strategy vision over a 50 year-time period.
7. A number of actions were identified to assist EW and TCDC to further refine the strategy vision and options to progress the CEMS into the next stage.
8. The final Buffalo Beach CEMS was then externally reviewed.

The preferred options for each section of Buffalo Beach have been determined by considering the economic, social and environmental impacts of options and selecting those that are most likely to achieve triple bottom line outcomes.

The background to the project and the methodology used to develop the Buffalo Beach CEMS is detailed in Appendix A.

3 Description of Buffalo Beach

Buffalo Beach is a fine-medium sand beach, approximately 3km long, located at the head of Mercury Bay. Mercury Bay acts to shelter Buffalo Beach from most swell and sea waves - the beach being directly exposed to ocean wave action over only a relatively narrow segment from the east and northeast. Wave refraction, diffraction and shoaling significantly affect swell and sea waves entering the Bay and wave energy distribution can vary significantly according to wave direction and period (Smith, 1980). The northern end of the beach is generally subject to less severe wave action than the central and southern areas.

Mercury Bay is subject to moderately significant storm surge effects, with water levels elevated about 0.8m above predicted astronomical tides during the major storm of July 1978. Waves commonly overtop back beach areas during coastal storms due to the combined effect of waves and storm surge.

Whitianga Harbour, a large tidal estuary (tidal prism approximately 16 million cubic metres), discharges at the southern end of the beach (Figure 2). An ebb tide delta, formed by flows discharging from the harbour entrance, lies offshore from the beach but the feature is very low lying (Figure 2).

Figure 2: Buffalo Beach showing Whitianga Estuary entrance at southern end



Subdivision at the southern end of the beach dates from the late 1800's and the foreshore roads in this area were placed close to the sea. There is also beachfront subdivision and development on the seaward side of the state highway, at the northern end of the beach, dating from the 1950's. In central areas of the beach, roads and private property are well setback from the sea with wide grassed public reserves in this area.

Buffalo Beach, named after a vessel wrecked on the beach in 1840, is the largest beach in the Mercury Bay area and the main beach for Whitianga Township. Whitianga is the second largest township on the Eastern Coromandel and is a popular coastal destination in the Coromandel – the local beaches ranking fifth among the top ten beaches visited by respondents in a recent survey conducted in the Waikato Region⁶.

The population of Whitianga increases significantly (about 7 fold) during peak seasons. Absentee owners make up of 48% of the ratepayers' roll⁷. The majority of absentee ratepayers are likely to be originated from Auckland and the Waikato, following the breakdown of the Coromandel as a whole. It has been projected that both the permanent population and absentee dwellings are likely to increase.

⁶ Environment Waikato, 2003

⁷ Lesley McCormick, Area Manager, TCDC Whitianga, 2004

Average capital value of properties on the seaward side of the road at the northern end of Buffalo Beach is presently about \$709,000. This is well below the capital value of similar beachfront properties elsewhere on the Coromandel and suggests that the values of the properties are being adversely impacted by uncertainties surrounding the existing erosion issue. The capital values of the worst affected properties at the southern end of the beach (1-18 Buffalo Beach Road – where the existing high risk hazard line incorporates most of the area of the beachfront sections) appear to be significantly less affected by the existing hazard risk. The average capital value in this area is about \$1,000,000. The closer proximity of the properties at the southern end of the beach to the town centre is undoubtedly a contributing factor to the higher values in this area.

Whitianga is rich in Maori history. The name Whitianga is short for Te Whitianga-a-Kupe (Kupe's Crossing Place) in memory of Kupe's arrival after crossing the ocean from Tahiti (Riddle, 1996). The presence of Kupe is commemorated by various place names around the area. Just north of Buffalo Beach is Ngati Hei's turangawaewae - including the historic headland pa site, Wharetaewa, overlooking Wharekaho Bay. Archaeological investigation has revealed many centuries of continuous occupation here, making it one of the oldest inhabited sites in New Zealand⁸.

4 Is there a Coastal Hazard at Buffalo Beach?

4.1 Natural Erosion Mechanism

There is some evidence that the foreshore roads along the south end of Buffalo Beach experienced periodic erosion problems prior to the 1960's, but particularly serious erosion appears to have commenced in the early 1960's, requiring the placement of rock armour to protect the state highway and parts of the Esplanade.

The causes of the serious erosion problem are not clear, though they could include offshore changes related to the severe tsunami event of May 1960, storm cycles and/or seaward widening of the road.

The central and northern areas of the beach have experienced periodic storm cut erosion and recovery over time, but a period of very serious erosion and shoreline retreat commenced in this area in mid 1995.

At the northern end of the beach, fronting the development on the seaward side of the highway, the seaward toe of dune cut back by about 20-30m between the mid 1990's and a period of sustained easterly weather in mid 2000 – leading to initiation of the present seawall in this area. There is also some evidence that erosion cut back to a similar point in this area in the late 1950's.

The available evidence suggests the erosion at Buffalo Beach is primarily related to dynamic shoreline fluctuations, rather than ongoing permanent shoreline retreat.

⁸ <http://www.ngatihei.iwi.nz>

The available evidence suggests the erosion at Buffalo Beach is primarily related to dynamic shoreline fluctuations⁹, rather than ongoing permanent shoreline retreat¹⁰. The primary causes of the erosion appear to be periods of increased and decreased storminess (i.e. climate cycles associated with ENSO and IPO) and the influence of the adjacent ebb tide delta. The influence of climate cycles is suggested by the fact that the periods of beach and dune recovery and of erosion coincide with the general pattern observed along the eastern coast of the Coromandel and the Bay of Plenty. The influence of the ebb tide delta on the erosion is suggested by the pattern of shoreline change evident in offshore profile data and by anecdotal reports that the erosion has coincided with shallowing over parts of the ebb tide delta.

4.2 What is at Risk?

It is clear from historic damage, both in the early 1960's and the period from 1995, that, in the absence of effective protection works, erosion poses a hazard to the former state highway at the southern end of the beach and to the properties (and probably some dwellings) on the seaward side of the road at the northern end of the beach.

- **The development setback lines recently developed by Environment Waikato suggest that, at present, there are 68 properties and 43 dwellings that could potentially be impacted by erosion in the absence of shoreline protection works. These properties have a combined capital value of about \$43 million, though the present market value of the properties is probably closer to \$60 million.**
- **In the longer-term future, erosion may be further aggravated by projected sea level rise¹¹ and changing weather patterns, particularly in the period beyond 2050 AD. Environment Waikato estimates¹² suggest there are 80 properties and 56 dwellings within the affected areas at both the northern and southern ends of the beach potentially impacted. These properties have a combined capital valuation of \$56 million, though the present market value is probably closer to \$70 million.**
- **Public reserve land along Buffalo Beach is also vulnerable to coastal erosion and small remaining reserve areas at the northern and southern ends of the beach may be lost altogether in the future.**

⁹ See Glossary in Appendix L for definition on dynamic shoreline fluctuations

¹⁰ Dahm and Munro, 2002

¹¹ Sea level rise predicted to be 0.5 m over the next 100 years (International Panel for Climate Change)

¹² Mark Williams, Environment Waikato Geospatial Analyst, pers. comm. July 29004.

4.3 Past Response to Coastal Erosion

To date, the primary response of the road managers and private property owners to coastal erosion has been the placement of various seawalls. Council has also placed limited lengths of armouring in these areas – to protect a toilet block on the foreshore towards the southern end of the beach; and to protect a reserve suffering end effects erosion from adjacent seawalls at the northern end of the beach.

The seawalls adjacent to the foreshore roads (Buffalo Beach Road and The Esplanade) at the southern end of the beach and to properties and coastal reserve at the northern end are moderately robust but have significant weaknesses and are unlikely to be certified as appropriate long-term protection by competent coastal engineers.

To date, the primary response of the road managers and private property owners to coastal erosion has been the placement of various seawalls.

Most of the existing structures have been constructed without necessary consent and are exhibiting significant adverse environmental effects. For example, the existing structures commonly reduce the width of high tide dry beach immediately adjacent to the roads at the southern end of the beach (especially the section of seawall north of Albert Street) and along the front of the properties at the northern end, adversely impacting on natural character, visual amenity, and recreational values.

The background to Buffalo Beach and the coastal erosion problem is detailed further in Appendix B.

5 Strategy Vision and Objectives

To facilitate the assessment of options for the Buffalo Beach CEMS a draft strategy vision and objectives were developed to identify desired outcomes over the next 50 years. Consultation with the community and stakeholders is a key part of developing a vision and objectives for any strategic planning such as this, but was not undertaken as part of this project. The draft vision and objectives have therefore been developed based on community consultation undertaken as part of both the EW and TCDC Long Term Council Community Plan (LTCCP) processes and also the experience gained from past strategic studies undertaken by the project team. It is expected that this vision and objectives will be further refined through consultation with the community.



Objectives:

- ✓ Take a sustainable approach to shoreline management based on an assessment of economic, environmental and social impacts of options for coastal defence.
- ✓ Proactively reduce the level of risk on coastal communities from current and future coastal hazards by using appropriate management techniques whilst providing for growth of the township.
- ✓ Protect and enhance the amenity values of Buffalo Beach.
- ✓ Facilitate a co-ordinated approach to managing coastal hazard risks between property-owners, communities, tangata whenua and key stakeholders.

6 How were Options Screened?

There were a number of options available for the management of the Buffalo Beach coastal erosion hazard. However, some options were impractical for Buffalo Beach. Factors that made some options impractical included technical design issues such as an incompatibility between the structure being considered and the site conditions or an unacceptable level of risk caused by some options (such as navigational hazard). These factors are called “Fatal Flaws” and it was necessary to conduct a screening level assessment before suitable options were investigated further for environmental, economic and social impacts. This was achieved via a checklist approach where each option was looked at for technical feasibility and either ticked for further assessment or discarded with a justification provided on why that particular option is not considered further.

Refer to Checklist in Appendix D for the initial screening of options

7 What Options were Assessed?

Following the screening assessment of all options, a number of options were identified as being technically or practically viable for each section of Buffalo Beach and were taken through to the next stage for full multi-criteria analysis assessment. These options are described briefly below. Not all options were assessed for each section of Buffalo Beach and this is indicated in the option description. The diagrams provided below are generic structures intended to assist with an understanding of the options but do not provide any design specifics, scale, etc. For further details refer to Appendix E.

Status Quo: This option is essentially a continuation of the existing situation that has been established for the last 25-30 years and involves maintenance of existing structures.

This option was assessed for all three sections of Buffalo Beach.

Living with Coastal Erosion: Involves living with coastal erosion, managing use and development of the land to minimise risk to dwellings. This option does not provide protection to dwellings, as there is insufficient room on some properties for the dwelling to be relocated outside of the hazard setbacks.

This option was assessed for Buffalo Beach Northern section only.

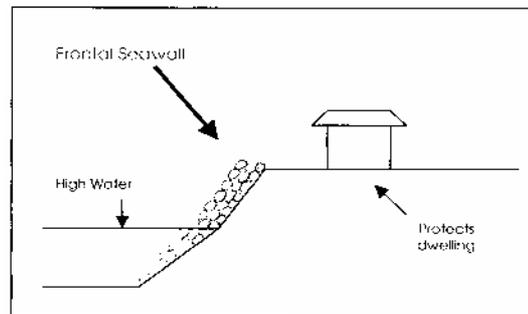
Dune Restoration: This option involves the proactive restoration of a frontal dune by replanting with native sand binding species and fencing to restrict access while plants re-establish.

This option was assessed for Buffalo Beach Mid section only.

Purchase of Beachfront Properties and Rezone Open Space: This option involves purchase of affected properties at current market value, removal of dwellings, removal of existing coastal structures, restoration of the natural dune (both front and back dune) and designation of the area as a reserve (i.e. Open Space).

This option was assessed for Buffalo Beach Northern and Southern sections.

Frontal Seawall: Seawalls are constructed parallel to the coastline. The primary purpose of a seawall is to protect the land behind from wave and current action. They maintain the coastline in a fixed position, similar to a headland. The seawall would be an engineered structure, probably constructed of rock. While seawalls protect the land behind them the beach in front of them is often lost.



This option was assessed for Buffalo Beach Northern and Southern sections.

Frontal Seawall and Rezoning Beachfront Properties to Town Centre: This option involves the rezoning of the existing beachfront residential areas to *Town Centre Zone*. It also involves the protection of foreshore roads and the private properties further landward through the replacement of the existing foreshore structures with a properly engineered rock wall - located along the alignment of the existing structures (see frontal seawall description above).

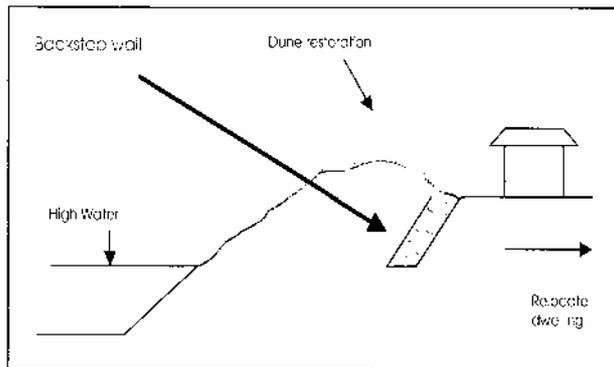
This option was assessed for Buffalo Beach Southern section only.

Realign Existing Frontal Seawall Landwards and One Laning of the Road: This option involves the use of an engineered seawall to protect private properties. The wall would be located as far landward as practical to mitigate adverse effects on the beach. To accommodate the realigned seawall the road in this area would be reduced either to a one-way road or closed and reduced to an access lane for foreshore properties.

This option was assessed for Buffalo Beach Southern section only.

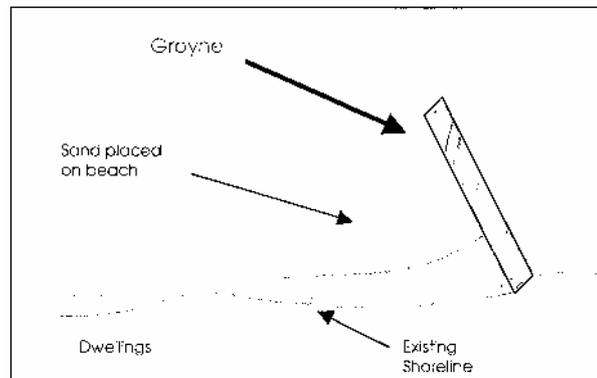
Relocate dwellings and redevelopment with backstop wall:

This option involves the relocation of up to five buildings landward on the property and redevelopment of the site by constructing an engineered wall located sufficiently far enough landward (approx. 10-20m) so that the wall is buried and only exposed in extreme storm events. The sand in front of the backstop wall provides a natural dune buffer to protect relocated properties and maintains an exposed beach.



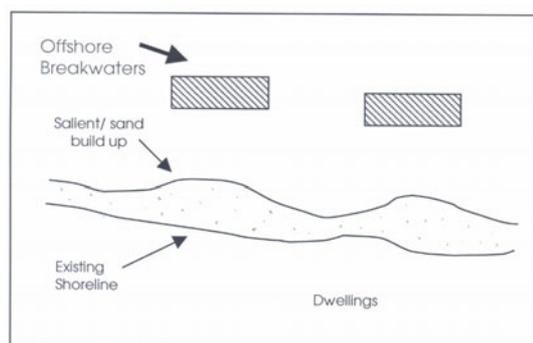
This option was assessed for Buffalo Beach Northern section only.

Groyne(s) plus nourishment: Groynes are narrow structures constructed perpendicular to the coastline. In this instance they are more like headland structures to retain a wider beach. In this location the groyne option would also require nourishment of the beach to create a wider beach through the importing of sand and infrequent renourishment.



This option was assessed for Buffalo Beach Northern and Southern sections.

Offshore Breakwater and nourishment: Offshore breakwaters are structures usually built parallel and offshore to the coast. Wave energy is either dissipated, reflected, refracted or diffracted resulting in reduced wave energy environment in lee of the breakwater. The breakwater can be built either to be submerged or emerging at low tide. It would also require placement of sufficient sand to assist the build up of a salient.



This option was assessed for Buffalo Beach Northern Section only.

8 How were Social, Environmental and Economic Impacts Evaluated?

Once feasible options were selected from the initial screening level checklist, the selected options received a further assessment against a range of indicators separated under the three broad categories of environmental, social and economic analysis.

What do the Indicators Mean?

A whole series of indicators were carefully selected and developed based on sustainable development principles to assess the impacts of each option against. These indicators are described briefly in the table below. Each indicator was graded in terms of the impacts (either positive, negative or both) and the level of this impact (low, medium and high) – for some indicators the positive or negative impact was considered to be not applicable. Further details on the descriptions of each indicator and their gradings are provided in Appendix G.

The indicators cover a range of potential impact categories including items stated as matters of national importance in the RMA (e.g. public access, historic heritage, natural character etc), matters considered important for beachfront property owners (e.g. protection of private property, private capital, capital costs) and values that may be important for the wider community (e.g. natural character and beach amenity). There are also categories of importance to stakeholders such as the Department of Conservation (e.g. biodiversity, environmental footprint) and the local authority (e.g. impact on Council, policy/statutory compliance).

Selected Social Impacts	Policy Compliance	The degree to which the management option complies with existing national, regional and district policies/provisions/guidance.
	Beach Amenity Values	Refers to peoples 'sense of place, visual aesthetics of the option, public access and recreational impacts such as cycling, walking running, surfing, boating, etc.
	Public Access	Public access is considered to be access both to and along the coast. This is a matter of national importance in the RMA.
	Construction Nuisance	Refers to disruptions, interference and noise levels impacting on residents, local community and visitors from any construction works (either temporary placement or on-going maintenance).
	Public Safety	The level of impact on public safety from the option, such as navigation safety, accident caused by construction activities and injury/life risk to property owners.

	Impact on Council	The extent to which the option relieves, maintains or increases pressure and/or Council liability to undertake coastal protection works to safeguard private property. Pressure may be compounded by increasing number of properties at risk. Also refers to level of commitment required by council in the long-term in regards to maintenance, resources, etc.
	Uncertainty	The level of uncertainty the option has for property owners on the extent of protection afforded against future erosional events, i.e. loss of, or damage to, property.
	Public Resistance	Refers to the expected resistance levels, public perceptions and disagreements within the community as a result of a proposed action.
	Cultural Values	Includes consideration of the impact on values important to tangata whenua. This category has not been assessed as the information on this can only be obtained through consultation with tangata whenua.
	Historic Heritage	Refers to natural and physical resources that contribute to an understanding and appreciation of NZ's history and cultures. Includes a broad assessment of potential impacts on both recorded and unrecorded archaeological sites. This is a matter of national importance in the RMA.
	Equity	Assessment of the balance of benefits to be gained between the wider community and private beachfront property owners, etc.
Selected Environmental Impacts	Biodiversity	Refers to the impact of the option on indigenous species and habitats including endangered and threatened species within the coastal environment.
	Natural Character	Refers to the extent of impact on natural landforms, ecosystems and natural processes. Defined as a matter of national importance in the RMA.
	Coastal Processes	The extent of the impact on natural coastal processes such as wave action, currents and resulting sediment movement.
	Coastal Flooding	Refers to the effect of the option on coastal flooding risk. It includes wave overtopping, storm surge, wave run-up, etc
	Climate Change	How will the option face future expected climate change and the effects of global warming, associated sea level rise and effects on coastal erosion.

	Environmental Footprint	Refers to the degree of impact on environmental resources (such as type of resources needed, amount, etc). It refers to how we might quantify our use of nature and compare with the carrying capacity of our environment.
	Reversibility of option	How easy is the option to reverse and restore the affected area back to its original state prior to when the option was implemented?
Selected Economic Impacts	Structure Construction, Works and Maintenance Costs	Initial capital costs associated with construction of engineered structures and maintenance/works associated with the option over a 50-year timeframe.
	Capital Costs	Refers to the cost of property relocation or purchase associated with some options.
	Local Economy	Refers to the contribution and spill over effects the option has on the local economy, i.e. the potential for increased local employment, spending and other economic activities in the local community.
	Transaction Costs	Refers to the efforts and hence the costs that go into organising, negotiating, entering into contracts and the implementation of the option (e.g. resource consents).
	Tourism	The contribution of the option towards local tourism in terms of visitor numbers, tourist spending, etc
	Private Capital	The extent to which the option affects both private capital and equity gain such as an increase or decrease in property values, both the adjacent beachfront properties and wider community. Includes cost of property relocation or purchase if required by an option.
	Protection of Public Infrastructure	Refers to how likely the option will provide protection for assets such as roads, public reserves, water, sewerage, electricity, gas and impacts on the costs to the council to relocate or restore this infrastructure and services.

Cultural values have been added as an indicator against which options must be assessed to demonstrate their importance in the consideration of any option. Although consultation with tangata whenua was not undertaken as part of this project, EW and TCDC have advised that a consultation programme is planned as part of the wider joint coastal erosion project and cultural values will be investigated at that stage.

Qualitative and Quantitative Assessment

All options were qualitatively assessed through a multi-criteria analysis against the indicators based on a time frame of 50 years¹¹ and the impact the option would have over that period. The assessments were based around the idea of a beach that would represent the strategy vision. Each option was assessed against the indicator and given a High, Medium or Low (H, M or L) positive or negative grading (depending on whether the impact of the option on that indicator is positive or negative in achieving the ideal beach state representative of the strategy vision). The assessment of each option against the indicators is shown in the matrix on the following page.

In addition to the above qualitative assessment an economic cost-benefit analysis of each option was also undertaken to quantitatively assess the level of impact the option will have. The economic analysis utilised cost-benefit analysis techniques to measure the overall well-being (or welfare) impacts of the different options for coastal management and macro-economic techniques to measure impacts on the size of the local economy. The economic analysis is detailed in Appendix F.

No specific design work was undertaken as part of this study and therefore structure construction, works and maintenance costs used in the assessments are estimates for generic structures (e.g. seawall).

9 How did the Options Stack Up?

Once the options for each section of Buffalo Beach have been assessed against each indicator on the tables in Appendix H then the grading assigned to each category is inserted into a matrix table for evaluation. The following are the final matrices developed for each section of Buffalo Beach.

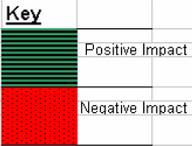
The qualitative assessment has been based on the consensus view of the project team. The views of the public play an important part in strategy development and implementation. These will be assessed through the consultation programme planned by EW and TCDC.

¹¹ Environment Waikato Contract 921518 Coastal Erosion Management Strategies for Cooks and Buffalo Beaches, 2004

How to use the Matrix: Each option along the top of the matrix has been assessed against the indicators down the left hand side of the table based on whether or not it will have a positive or negative impact (red represents negative impact, green is a positive impact). The length of the bar indicates the degree of impact. The gradings are either High (long bar), Medium (medium bar) or Low (short bar) positive/negative impacts. No bar indicates that there is no impact (except for Cultural Values which have not been assessed in this study and therefore have no bars shown).

Buffalo Beach Southern Section Matrix (Qualitative Assessment)

		Option 1 Status Quo	Option 2 Council purchase + relocate + rezone	Option 3 Frontal Seawall	Option 4 Frontal Seawall + rezone to Town Centre	Option 5 Realign Seawall + One Lining of Road	Option 6 Groynes + nourish			
Selected Social Impacts	1	Policy/Statutory Compliance	High Negative	High Negative	High Negative	High Negative	High Negative			
	2	Beach amenity values	High Negative	High Positive	High Negative	High Negative	High Negative	High Positive		
	3	Public access	High Negative	High Positive	High Negative	High Negative	High Negative	High Positive		
	4	Construction nuisance	High Negative	Low Negative	High Negative	High Negative	High Negative	High Negative		
	5	Public safety	High Negative	Low Positive	High Negative	High Negative	High Negative	High Negative		
	6	Impact on Council (Council liability, pressure on Council, Council commitment)	High Negative	High Positive	High Negative	High Negative	High Negative	High Negative		
	7	Uncertainty	High Negative	High Positive	High Negative	High Negative	High Negative	High Negative		
	8	Public resistance	High Negative	High Negative	High Negative	High Negative	High Negative	High Negative		
	9	Cultural values								
	10	Historic Heritage	Low Positive	Low Positive	Low Positive	Low Positive	Low Positive	Low Positive		
	11	Equity	High Negative	High Positive	High Negative	High Negative	High Negative	High Negative		
Selected Environmental Impacts	12	Biodiversity - Species and Habitats	High Negative	High Positive	High Negative	High Negative	High Negative	High Positive		
	13	Natural Character	High Negative	High Positive	High Negative	High Negative	High Negative	High Positive		
	14	Coastal Processes	High Negative	High Positive	High Negative	High Negative	High Negative	High Positive		
	15	Coastal Flooding	High Negative	High Positive	High Positive	High Positive	High Positive	High Positive		
	16	Climate Change	High Negative	High Positive	High Negative	High Negative	High Negative	High Positive		
	17	Environmental Footprint (resource type and use)	High Negative	High Positive	High Negative	High Negative	High Negative	High Negative		
	18	Reversibility	High Positive	High Negative	High Negative	High Negative	High Negative	High Negative		
Selected Economic Impacts	19	Structure construction, works and maintenance costs	High Negative	High Negative	High Negative	High Negative	High Negative	High Negative		
	20	Capital costs (property costs only)	High Negative	High Negative	High Negative	High Negative	High Negative	High Negative		
	21	Local Economy	High Negative	High Positive	High Negative	High Positive	High Negative	High Positive		
	22	Transaction Costs	High Negative	High Negative	High Negative	High Negative	High Negative	High Negative		
	23	Tourism	High Negative	High Positive	High Negative	High Positive	High Negative	High Positive		
	24	Private Capital	High Negative	High Positive	High Negative	High Positive	High Negative	High Positive		
	25	Protection of Public Infrastructure	High Positive	High Positive	High Positive	High Positive	High Positive	High Positive		



How to use the Matrix: Each option along the top of the matrix has been assessed against the indicators down the left hand side of the table based on whether or not it will have a positive or negative impact (red represents negative impact, green is a positive impact). The length of the bar indicates the degree of impact. The gradings are either High (long bar), Medium (medium bar) or Low (short bar) positive/negative impacts. No bar indicates that there is no impact (except for Cultural Values which have not been assessed in this study and therefore have no bars shown).

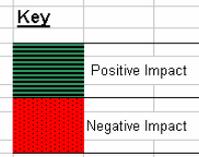
Buffalo Beach Mid Section Matrix (Qualitative Assessment)

		Option 1	Option 2		
		Status Quo	Dune Restoration		
Selected Social Impacts	1	Policy/Statutory Compliance			Key Positive Impact Negative Impact
	2	Beach amenity values			
	3	Public access			
	4	Construction nuisance			
	5	Public safety			
	6	Impact on Council (Council liability, pressure on Council, Council commitment)			
	7	Uncertainty			
	8	Public resistance			
	9	Cultural values			
	10	Historic Heritage			
	11	Equity			
Selected Environmental Impacts	12	Biodiversity - Species and Habitats			
	13	Natural Character			
	14	Coastal Processes			
	15	Coastal Flooding			
	16	Climate Change			
	17	Environmental Footprint (resource type and use)			
	18	Reversibility			
	19	Structure construction, works and maintenance costs			
Selected Economic Impacts	20	Capital costs (property costs only)			
	21	Local Economy			
	22	Transaction Costs			
	23	Tourism			
	24	Private Capital			
	25	Protection of Public Infrastructure			

How to use the Matrix: Each option along the top of the matrix has been assessed against the indicators down the left hand side of the table based on whether or not it will have a positive or negative impact (red represents negative impact, green is a positive impact). The length of the bar indicates the degree of impact. The gradings are either High (long bar), Medium (medium bar) or Low (short bar) positive/negative impacts. No bar indicates that there is no impact (except for Cultural Values which have not been assessed in this study and therefore have no bars shown).

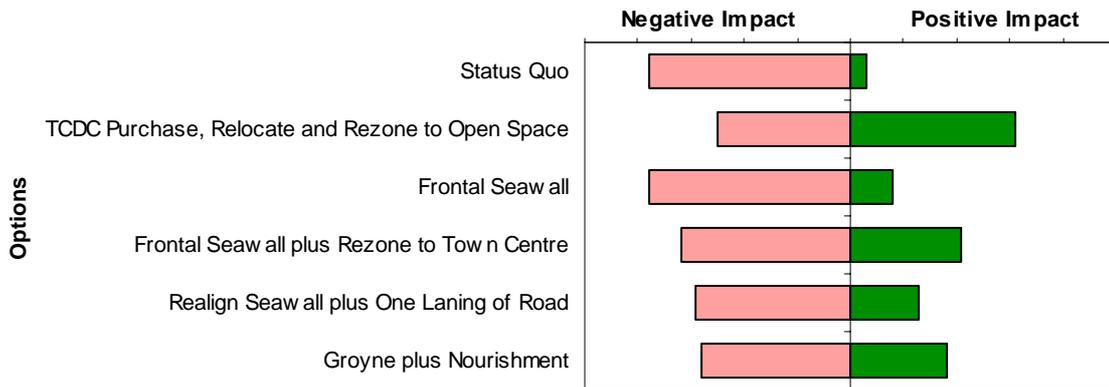
Buffalo Beach Northern Section Matrix (Qualitative Assessment)

		Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7		
		Status Quo	Living with coastal erosion	Council purchase + relocate	Frontal Seawall	Relocate dwellings and redevelop with backstop wall	Groyne + nourish	Offshore breakwater + nourish		
Selected Social Impacts	1	Policy/Statutory Compliance	High Negative	High Positive	High Positive	High Positive	High Positive	High Positive	High Positive	
	2	Beach amenity values	High Negative	High Positive	High Positive	High Positive	High Positive	High Positive	High Positive	
	3	Public access	High Negative	High Positive	High Positive	High Positive	High Positive	High Positive	High Positive	
	4	Construction nuisance	High Negative	High Positive	High Positive	High Positive	High Positive	High Positive	High Positive	
	5	Public safety	High Negative	High Positive	High Positive	High Positive	High Positive	High Positive	High Positive	
	6	Impact on Council (Council liability, pressure on Council, Council commitment)	High Negative	High Positive	High Positive	High Positive	High Positive	High Positive	High Positive	
	7	Uncertainty	High Negative	High Positive	High Positive	High Positive	High Positive	High Positive	High Positive	
	8	Public resistance	High Negative	High Positive	High Positive	High Positive	High Positive	High Positive	High Positive	
	9	Cultural values								
	10	Historic Heritage	High Negative	High Positive	High Positive	High Positive	High Positive	High Positive	High Positive	
	11	Equity	High Negative	High Positive	High Positive	High Positive	High Positive	High Positive	High Positive	
Selected Environmental Impacts	12	Biodiversity - Species and Habitats	High Negative	High Positive	High Positive	High Positive	High Positive	High Positive	High Positive	
	13	Natural Character	High Negative	High Positive	High Positive	High Positive	High Positive	High Positive	High Positive	
	14	Coastal Processes	High Negative	High Positive	High Positive	High Positive	High Positive	High Positive	High Positive	
	15	Coastal Flooding	High Negative	High Positive	High Positive	High Positive	High Positive	High Positive	High Positive	
	16	Climate Change	High Negative	High Positive	High Positive	High Positive	High Positive	High Positive	High Positive	
	17	Environmental Footprint (resource type and use)	High Negative	High Positive	High Positive	High Positive	High Positive	High Positive	High Positive	
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	20	Capital costs (property costs only)	High Negative	High Positive	High Positive	High Positive	High Positive	High Positive	High Positive	
	21	Local Economy	High Negative	High Positive	High Positive	High Positive	High Positive	High Positive	High Positive	
	22	Transaction Costs	High Negative	High Positive	High Positive	High Positive	High Positive	High Positive	High Positive	
	23	Tourism	High Negative	High Positive	High Positive	High Positive	High Positive	High Positive	High Positive	
	24	Private Capital	High Negative	High Positive	High Positive	High Positive	High Positive	High Positive	High Positive	
	25	Protection of Public Infrastructure	High Negative	High Positive	High Positive	High Positive	High Positive	High Positive	High Positive	



The graph below shows, in summary form, the results of the qualitative matrix for Buffalo Beach Southern section. The results show that the option of “Council Purchase Beachfront Land, Relocate Buildings and Rezone Open Space” had the most positive and least negative impacts (assuming equal weighting of impacts).

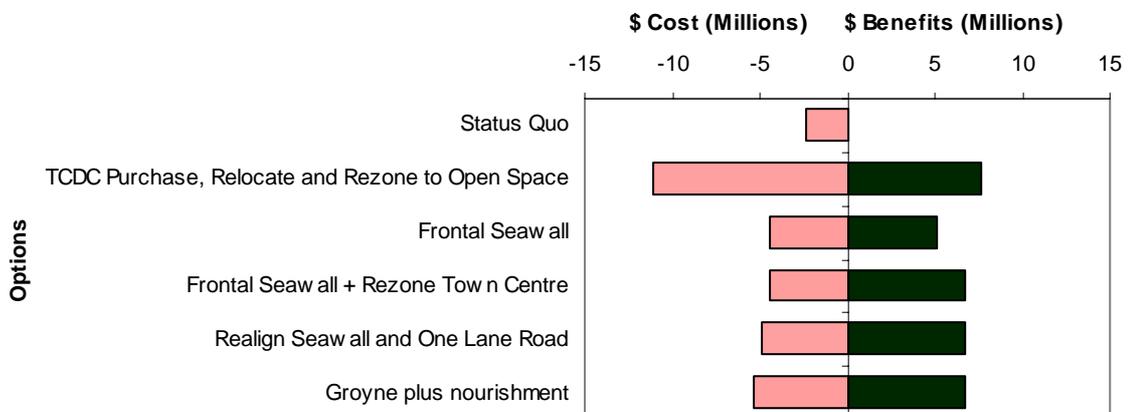
**BUFFALO BEACH SOUTHERN SECTION -
QUALITATIVE ANALYSIS SUMMARY**



The economic analysis considered the capital costs, property loss/gain, naturalness gains and the net economic benefit/costs of each option for society as a whole and also separately for the individual beachfront property owners and the wider community.

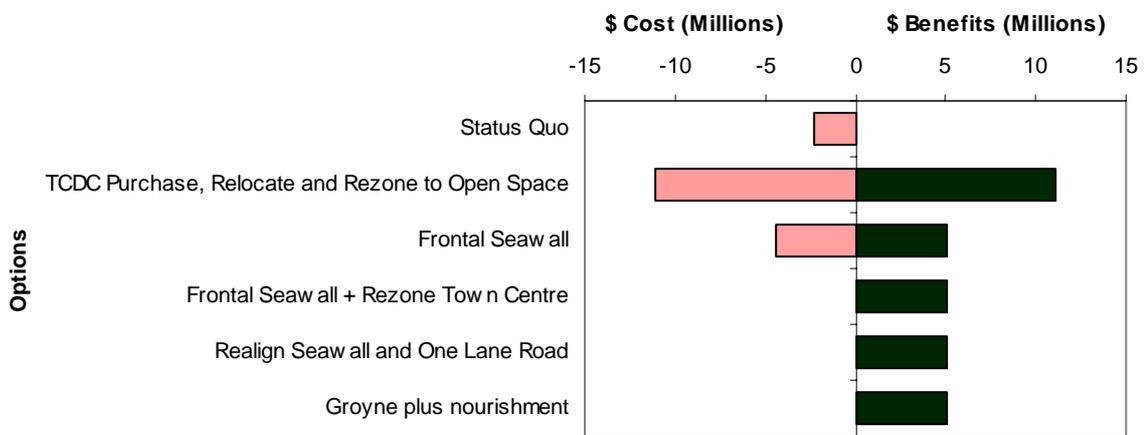
Considering the whole society (both beachfront owners and the wider community), the summary graph for the economic cost benefit analysis for Buffalo Beach South (below) shows the option of “Frontal Seawall and Rezone to Town Centre” is the most desirable as it has the most economic benefits compared with costs over a 50-year time horizon, followed closely by the options of “Realign Frontal Seawall and One Lane Road” and “Groyne plus Nourishment”.

**BUFFALO BEACH SOUTHERN SECTION COASTAL EROSION
MANAGEMENT STRATEGY
- COST BENEFIT ANALYSIS (Whole Society)**



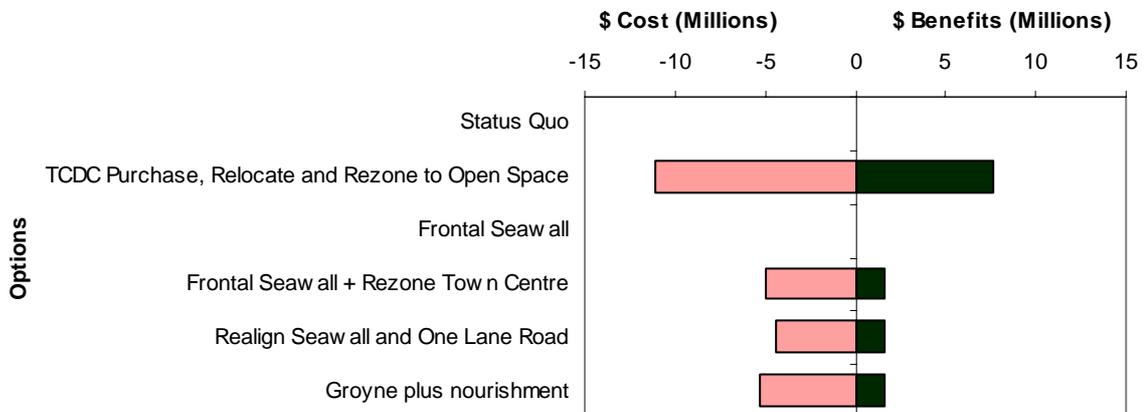
The following summary graph shows the net economic benefit/costs of each option for the individual beachfront property owners only. The graph shows that although the relocate and rezone option has the greatest economic benefits for individual property owners at Buffalo Beach South, it also comes with the greatest costs over the planning horizon of 50 years. The options of “Frontal Seawall and Rezone to Town Centre”, “Realign Seawall and One Lane Road” and “Groyne plus Nourishment” all have benefits and no costs for individual beachfront property owners.

**BUFFALO BEACH SOUTHERN SECTION COASTAL EROSION
MANAGEMENT STRATEGY
- COST BENEFIT ANALYSIS (Beachfront Owner)**

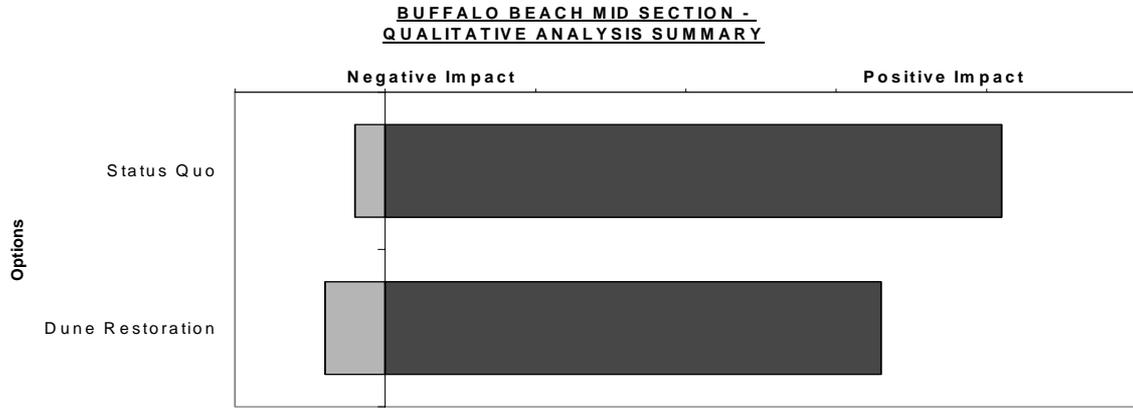


The summary graph below shows that the option of “TCDC Purchase, Relocate and Rezone to Open Space” has the greatest economic benefits for the wider community (excluding beachfront property owners) but comes with the greatest costs over the planning horizon of 50 years.

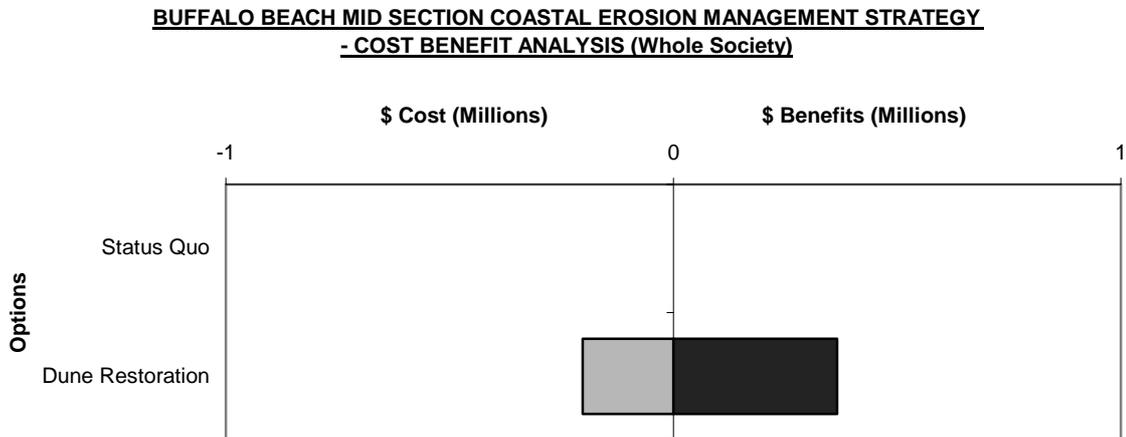
**BUFFALO BEACH SOUTHERN SECTION COASTAL EROSION
MANAGEMENT STRATEGY
- COST BENEFIT ANALYSIS (Wider Community)**



The qualitative matrix summary graph below for Buffalo Beach Mid section shows that both options of “Status Quo” and “Dune Restoration” have a number of positive effects and very little negative impacts over the 50-year planning timeframe. However, “Status Quo” is slightly more preferable from the qualitative assessment, having more positive and less negative impacts than “Dune Restoration”.

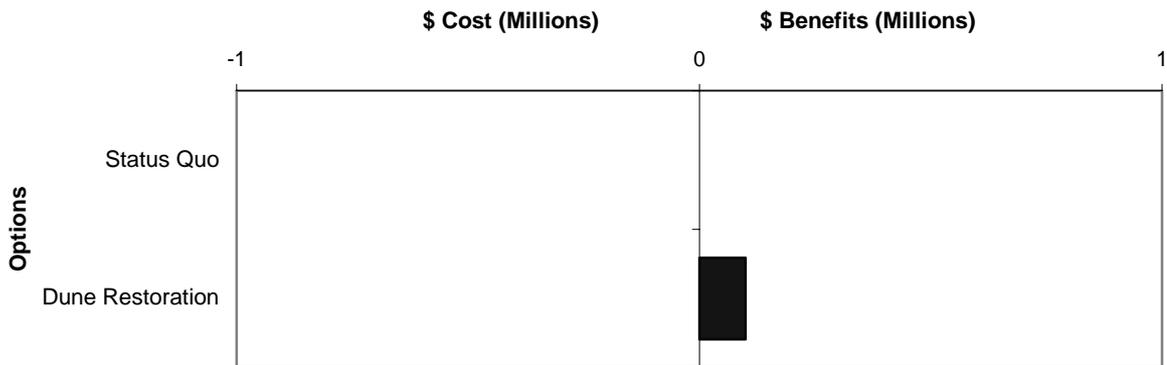


The economic summary graph for Buffalo Beach Mid section shows that there are both economic benefits and costs from the “Dune Restoration” option and no benefits or costs associated with the “Status Quo” option when considering the whole society.



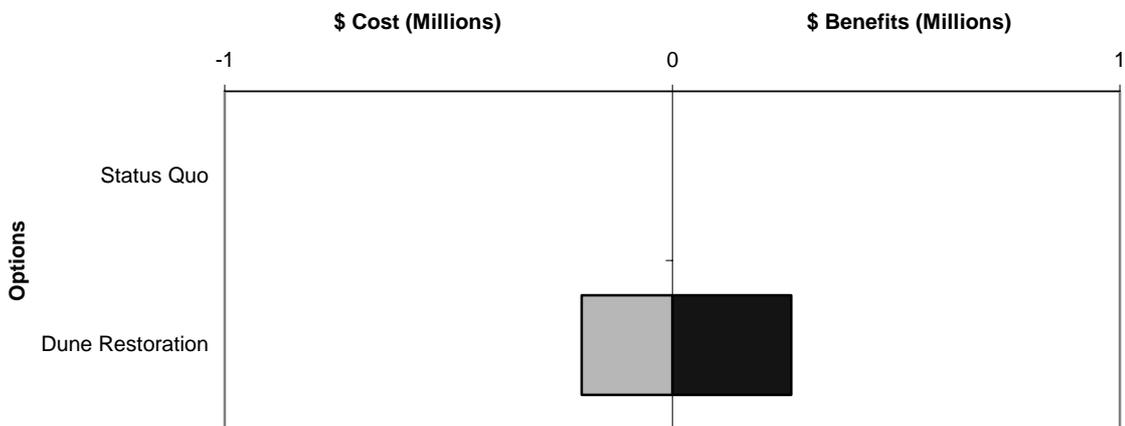
The following summary graph shows the net economic benefit/costs of each option for the individual beachfront property owners only. The graph shows that “Dune Restoration” has the greatest economic benefits for individual property owners at Buffalo Beach Mid section over the planning horizon of 50 years.

BUFFALO BEACH MID SECTION COASTAL EROSION MANAGEMENT STRATEGY
- COST BENEFIT ANALYSIS (Beachfront Owner)



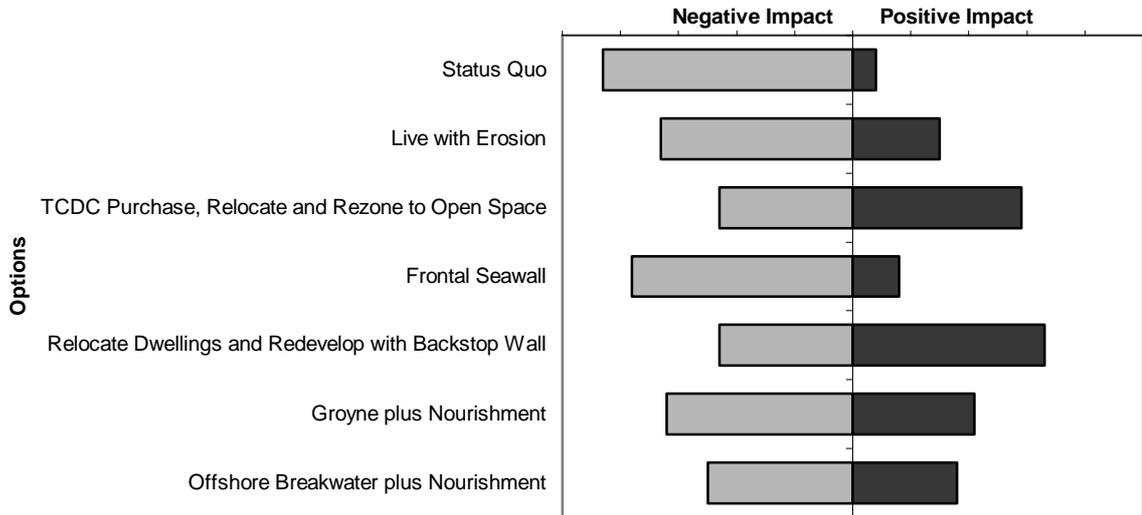
The summary graph below shows that there are both economic benefits and costs from the “Dune Restoration” option and no benefits or costs associated with the “Status Quo” option when considering the wider community (excluding beachfront property owners) over the planning horizon of 50 years.

BUFFALO BEACH MID SECTION COASTAL EROSION MANAGEMENT STRATEGY
- COST BENEFIT ANALYSIS (Wider Community)



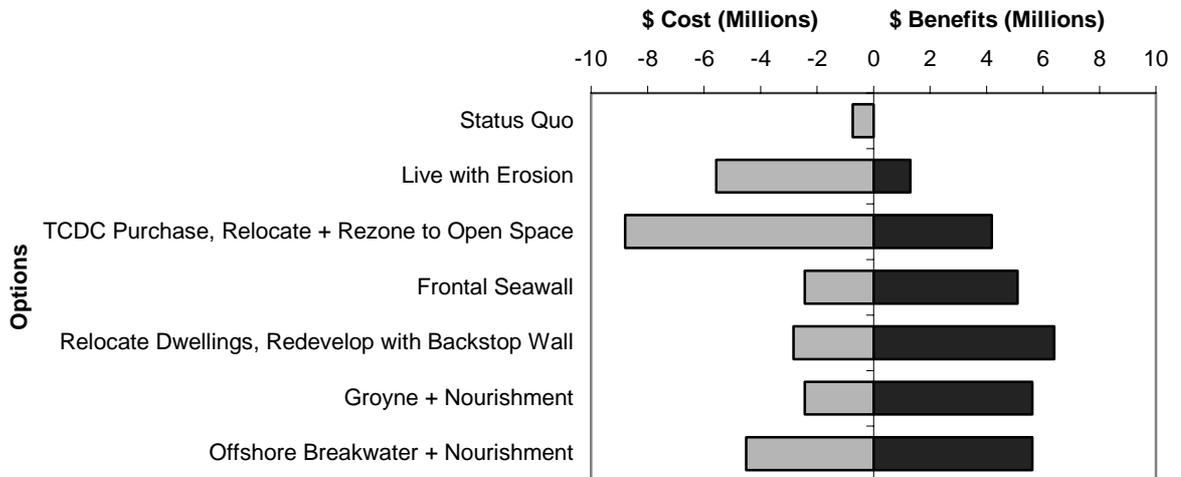
The summary graph of the qualitative matrix for Buffalo Beach Northern section (below) shows that the option of “Relocate Dwellings and Redevelop with a Backstop Wall” has the most positive and least negative impacts based on the consensus view of the project team.

**BUFFALO BEACH NORTHERN SECTION -
QUALITATIVE ANALYSIS SUMMARY**



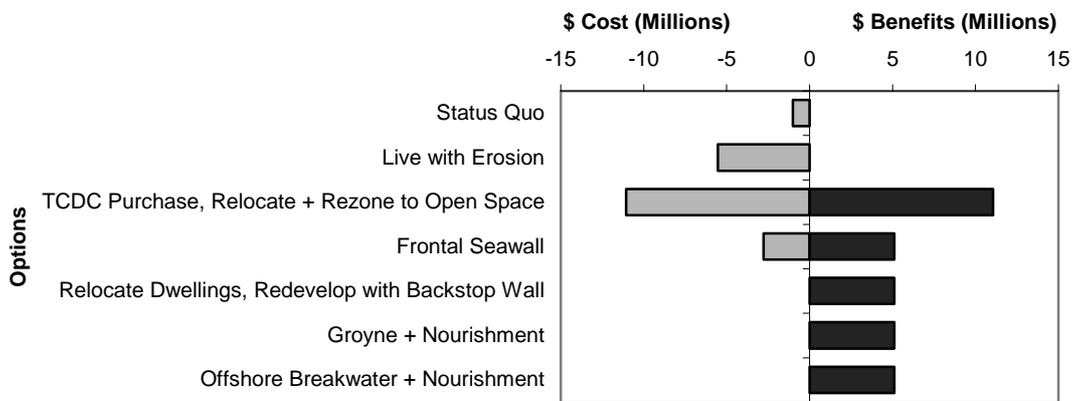
The summary graph of results of the economic analysis (below) for society as a whole shows the option of “Relocate Dwellings and Redevelop with a Backstop Wall” also had the most economic benefits of all options assessed for Buffalo Beach North.

**BUFFALO BEACH NORTHERN SECTION COASTAL EROSION
MANAGEMENT STRATEGY
- COST BENEFIT ANALYSIS (Whole Society)**



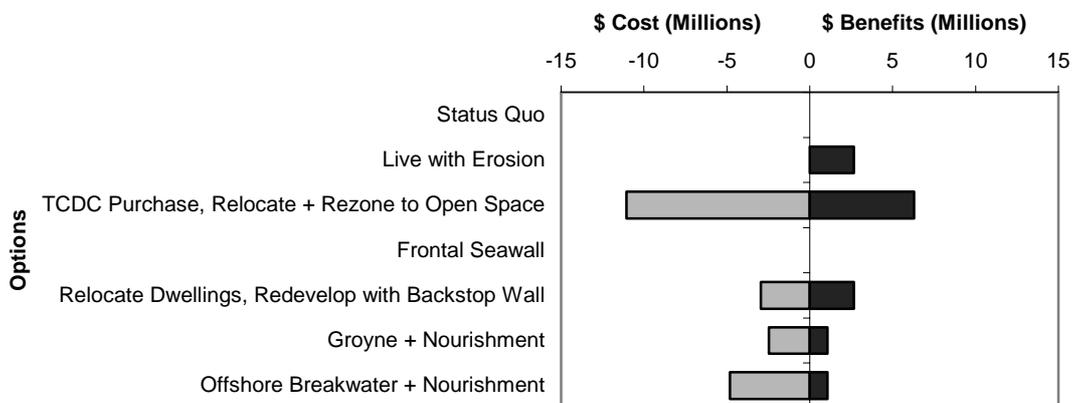
The following summary graph shows the net economic benefit/costs of each option for Buffalo Beach North for the individual beachfront property owners only. The graph shows that although the TCDC purchase, relocate and rezone option has the greatest economic benefits for individual property owners at Buffalo Beach South, it also comes with the greatest costs over the planning horizon of 50 years. The options of “Relocate Dwellings and Redevelop with a Backstop Wall”, “Groyne plus Nourishment” and “Offshore Breakwater plus Nourishment” all have benefits and no costs for individual beachfront property owners.

**BUFFALO BEACH NORTHERN SECTION COASTAL EROSION
MANAGEMENT STRATEGY
- COST BENEFIT ANALYSIS (Beachfront Owner)**



The summary graph below shows that the option of “TCDC Purchase, Relocate and Rezone to Open Space” has the greatest economic benefits for the wider community (excluding beachfront property owners) but comes with the greatest costs over the planning horizon of 50 years. “Live with Erosion” has significant benefits and no cost for the wider community at Buffalo Beach North.

**BUFFALO BEACH NORTHERN SECTION COASTAL EROSION
MANAGEMENT STRATEGY
- COST BENEFIT ANALYSIS (Wider Community)**



Summary of Results

From the qualitative assessment (matrix) and the quantitative economic analysis, the options that are most likely to achieve triple bottom line outcomes (and therefore the most likely to be a sustainable solution over the next 50 years and achieve the strategy vision) have been identified.

The qualitative assessment (multi-criteria analysis) has been based on the consensus view of the project team and has resulted in preferred options for each section of Buffalo Beach that may be further investigated and discussed with the community, iwi and other stakeholders. The economic analysis has assessed costs and benefits from the perspective of society as a whole as well as separating the analysis into beachfront property owners only and the wider community (excluding beachfront property owners) only.

The results of the two analyses show that there are a number of options that ranked highly in both assessments. Overall, the preferred options for Buffalo Beach South from both analyses are “Groyne plus Nourishment”, “Frontal Seawall plus Rezone Town Centre (Commercial)” and “Realign Frontal Seawall and reduce the road to One Lane”. Although “TCDC Purchase, Relocate and Rezone to Open Space” is the best option for Buffalo Beach South from the qualitative analysis, this option has high costs as shown in the economic analysis.

The preferred option for Buffalo Beach Mid section is “Dune Restoration”, which scored similarly to “Status Quo” in the qualitative assessment but has greater economic benefits for society as a whole in the longer term.

The preferred option in both the economic quantitative (whole society) and the qualitative (multi-criteria analysis) for Buffalo Beach Northern section is “Relocate Dwellings and Redevelop with a Backstop Wall”.

The external peer review undertaken supports the outcomes of the Buffalo Beach CEMS.

10 Conclusions and Action Plan

From the qualitative assessment (matrix) and the quantitative economic analysis, the options that are most likely to achieve triple bottom line outcomes (therefore the most likely to be a sustainable solution over the next 50 years and achieve the strategy vision) have been selected.

The results of both the qualitative matrix (multi-criteria analysis) and the quantitative assessment (cost benefit analysis) for Buffalo Beach Northern section show that the option of “Relocate Dwellings and Redevelop with a Backstop wall” has the most positive impacts and least negative impacts and the highest economic benefit over the longer term (50 years) of all options assessed for that section of Buffalo Beach. It is considered that there is opportunity for variations on this option for the Northern section to be further investigated such as boundary readjustments to acquire land in front of the backstop wall in public ownership.

The preferred option for Buffalo Beach Mid section is “Dune Restoration”, which scored similarly to “Status Quo” in the qualitative assessment but has greater economic benefits in the longer term. Dune restoration is also recognised as current best practice in coastal management.

The preferred options for Buffalo Beach South from both analyses are “Groyne plus Nourishment”, “Frontal Seawall plus Rezone Town Centre (Commercial)” and “Realign Frontal Seawall and reduce the road to One Lane”. It is possible that a combination of options for this section of beach would suit and this could be investigated further as well as undertaking preliminary design of the preferred options to further refine costs and benefits (see recommendations below).

The following provides a summary of those actions recommended to assist EW and TCDC further develop the Buffalo Beach CEMS. Further details are provided in Appendix J.

- **Investigative and Design Work (pre-consultation).** This study identified the need for further investigative or pre-feasibility work into selected options such as sensitivity analysis and preliminary design for engineered options to confirm costs and impacts, etc.
- **Feasibility Study (post-consultation).** Following identification of the most preferred option or combination of options (once community consultation has been completed) the option(s) will require further feasibility assessments (including field investigations and specific design) to make sure the option or combination of options is viable and practical to implement for each section of Buffalo Beach.
- **Funding Policies.** Investigations to identify the allocation for funding, and where the costs should fall for the selected options.
- **Consultation.** To further develop the CEMS for Buffalo Beach by taking the selection of options presented in this report to tangata whenua and the community for comment and discussion as well as to increase awareness and understanding of the CEMS at a local and regional level.

- **Monitoring Plan.** To review and further develop the CEMS following community consultation, to monitor physical processes and to undertake community surveys to monitor changing values.
- **Implementation Plan.** Develop an implementation plan for the preferred option(s) and include a timeframe of actions.
- **Master Plan for Southern Section.** The preferred options for Buffalo Beach South from both analyses are “Groyne plus Nourishment”, “Frontal Seawall plus Rezone Town Centre (Commercial)” and “Realign Frontal Seawall and reduce the road to One Lane”. It is possible that a combination of options for this section of beach would be appropriate and this could be investigated further as well as undertaking preliminary design of the preferred options to further refine the costs and benefits.
- **Resource Consents.** Proceed with appropriate resource consent applications for the preferred option(s) identified from consultation.