

Greater Wellington Regional Council

Multi Criteria Analysis Summary

Boulcott / Hutt Stopbank Feasibility Study

9th June 2008

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Greater Wellington Regional Council

Boulcott / Hutt Stopbank Feasibility Study May 2008 MCA Summary Document

Contents

1.	Introduction	1
2.	Alignment Options	2
2.1	Alignment Plans	2
2.2	Costings	5
3.	MCA (Multi Criteria Analysis)	6
3.1	Guiding Principles.....	6
4.	Attributes to Compare Alignment Options	8
4.1	List of Issues – Assembled in 2006	8
4.2	Definitions of Issues	8
4.3	Definitions of Proposed Attributes	10
4.4	Summary of MCA Attributes.....	11
5.	Scoring the Attribute against the Alignment Options	12
5.1	Introduction	12
5.2	Assumptions	12
5.3	Scoring the Attributes	13
6.	Weighting the Significance of the Attributes.....	15
6.1	Workshop Results	15
7.	MCA Result.....	17
8.	Sensitivity Analysis	18
8.1	Sensitivity of Scores	18
8.2	Sensitivity of Weightings	19
8.2.1	Weighting Schemes	19
8.2.2	Sensitivity Results	21

8.3	Concluding Comments.....	22
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List of Tables

Table 2-1 : Cost Estimates for Stopbank Alignment Options	5
Table 6-1 : Attribute Weights – Technical Team, Group Viewpoint.....	15
Table 6-2 : Attribute Weights – The Four Fundamentals	16
Table 6-3 : Attribute Weights – GWRC Consolidation of Attributes.....	16
Table 7-1 : Alignment Options	17
Table 8-1 : Variant Options.....	18
Table 8-2 : Table of Weightings Schemes	20
Table 8-3 : Attribute Sensitivities – GWRC Consolidation of Attributes.....	20
Table 8-4 : Table of Sensitivity Due to Weightings Schemes	21

List of Figures

Figure 2-1 : Red Alignment – Engineering Stopbank Cross Section for Full Length	2
Figure 2-2: Green alignment.....	2
Figure 2-3: Hutt Blue/Boulcott Green alignment	3
Figure 2-4: Hutt Green/Boulcott Alternative	3
Figure 2-5: Hutt Blue/Boulcott Alternative	4
Figure 2-6: Blue alignment.....	4

1. Introduction

The Boulcott/Hutt Stopbank Feasibility Study has considered the stopbank alignment options available between Kennedy Good bridge and Mills Street. A multi criteria analysis (MCA) technique has been used by the technical team to take account of a wide range of factors that are important to the community and stakeholders in selecting the best alignment option. This report details the second MCA process undertaken by the design team, with a workshop assessment conducted at GWRC offices on 21 May 2008.

An initial MCA process was undertaken in September 2006, by the design team to consider three alignments between Kennedy Good Bridge and Mills St. The three alignment options initially proposed for consideration were:

- red (nearest to Harcourt Werry Drive),
- green (Through both golf courses); and
- blue (near to the property boundary of the golf course and residential dwellings).

The design team divided the total alignment length into three sub-sections – Hutt Golf Course, Boulcott Golf Course and past Safeway Storage. Each sub-section was assessed as three separate options, and when joined with other subsections to complete the stopbank total length, 27 possible alignment combinations were then able to be ranked as shown in the following tables. Each option was assessed as an engineering stopbank cross section and as a golf friendly shape.

In the current MCA process, May 2008, the feasibility study of the Boulcott/Hutt stopbank alignment was sufficiently advanced to enable the MCA process to be applied to six alignment options, with each option a total length stopbank between Mills Street and Kennedy Good Bridge.

2. Alignment Options

2.1 Alignment Plans

The six alignments considered during the MCA process are shown below:

Figure 2-1 : Red Alignment – Engineering Stopbank Cross Section for Full Length

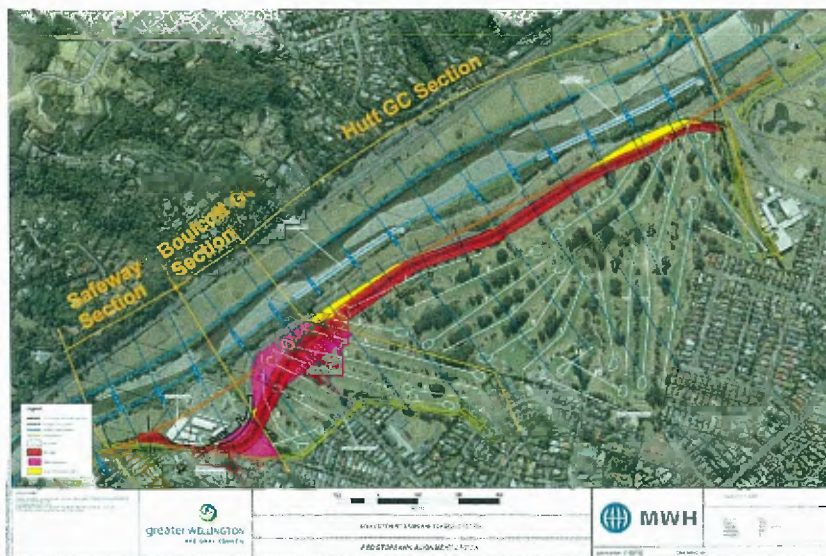


Figure 2-2: Green alignment
 Engineering stopbank cross section for full length



Figure 2-3: Hutt Blue/Boulcott Green alignment
 Golf friendly through HGC and an engineering stopbank through BGC

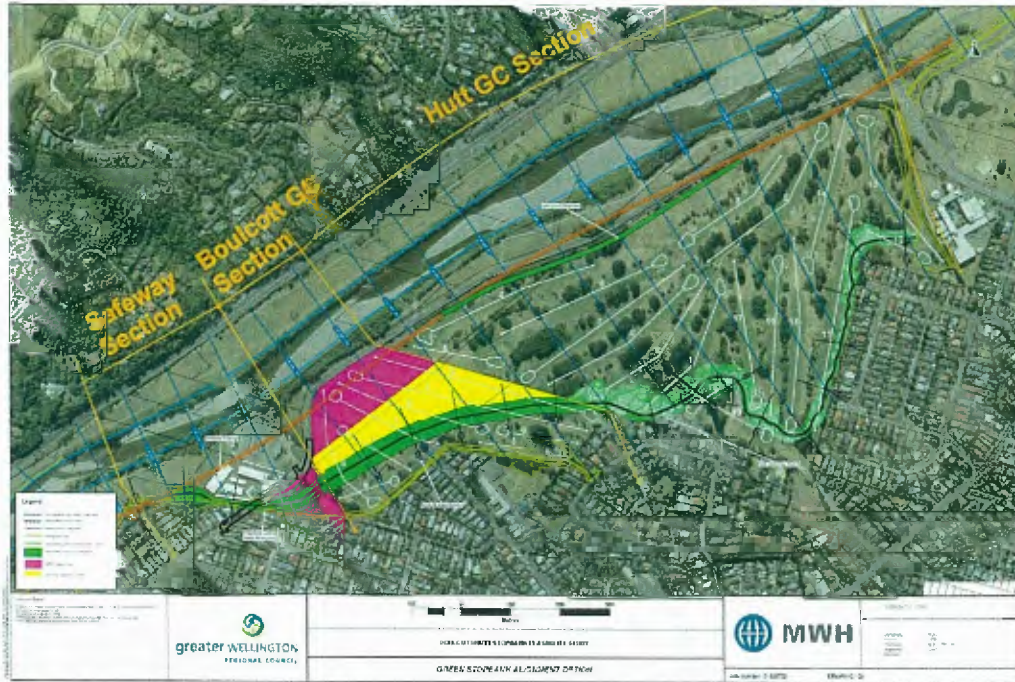


Figure 2-4: Hutt Green/Boulcott Alternative
 Engineering through HGC and the "Boulcott Alternative" through BGC

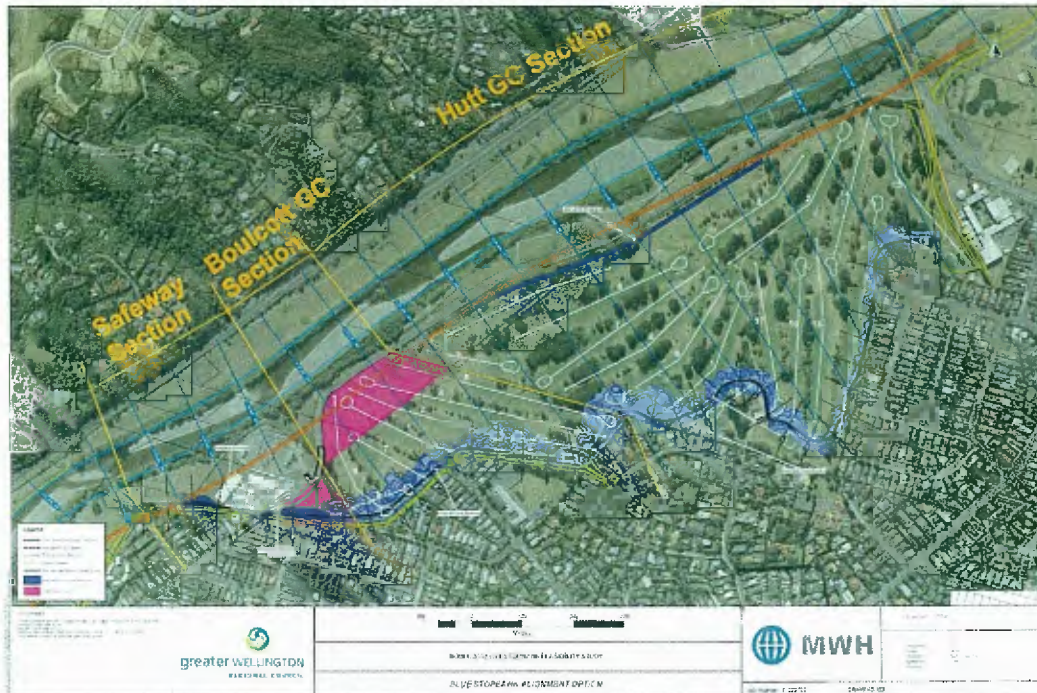


Figure 2-5: Hutt Blue/Boulcott Alternative

Golf friendly through HGC and the "Boulcott Alternative" through BGC


Figure 2-6: Blue alignment

Golf friendly alignment full length



2.2 Costings

Engineering costs, and property value and compensation costs, were estimated prior to the MCA work.

Table 2-1 : Cost Estimates for Stopbank Alignment Options

		Hutt Golf Club			
		Blue		Green	
BGC	Blue	BOULCOTT ALTERNATIVE OPTION		HUTT GREEN/BOULCOTT ALTERNATIVE	
		Engineering Costs	\$10,150,000	Engineering Costs	\$9,118,325
		Land Purchase	\$0	Land Purchase	\$2,491,450
		Compensation	\$2,669,000	Compensation	\$1,488,750
		SUM	\$12,800,000	SUM	\$13,100,000
BGC	Green	HUTT BLUE/BOULCOTT GREEN		GREEN	
		Engineering Costs	\$8,678,858	Engineering Costs	\$7,282,387
		Land Purchase	\$305,000	Land Purchase	\$2,796,450
		Compensation	\$1,416,000	Compensation	\$820,000
		SUM	\$10,400,000	SUM	\$10,900,000

		Hutt Golf Club			
		Blue		RED	
BGC	Blue	Blue GOLF FRIENDLY Option			
		Engineering Costs	\$11,457,000		
		Land Purchase	\$0		
		Compensation	\$3,745,000		
		SUM	\$15,200,000		
BGC	RED			Red ENGINEERING Option	
				Engineering Costs	\$9,922,000
				Land Purchase	\$0
				Compensation	\$1,860,000
		SUM	\$11,800,000		

3. MCA (Multi Criteria Analysis)

MCA is a powerful tool for establishing a balanced view of preferences amongst options in complex multi-dimensional decision problems. It provides a transparent tool that can guide decision making where many different competing issues are involved. Its use is consistent with the requirements of the RMA to consider alternatives.

Benefits arise not only in selecting preferences amongst options, but also in the process of structured discussions of their advantages and disadvantages within the formalism of an MCA approach. However, it is important to recognise that it is people that make decisions, and that the MCA should only be used as a tool to guide these decisions.

Two MCA processes have been used in the Boulcott/Hutt Stopbank Alignment feasibility study up to this point. The MCA process of 2006 was spread over 5 workshops and three public meetings, and issues were canvassed from all quarters including stakeholders and the general public. In the May 2008 MCA process, one workshop was held to summarise the alignment options on the basis of the most up to date information and using the work of 2006 as the foundation.

In 2006, the issues were grouped together into nine attributes and given an importance weighting by the technical team in a group discussion forum. In the May 2008 MCA process, one extra attribute was included into the MCA to represent the effects of the options on the golf club memberships, bringing the total number of attributes up to ten.

Each attribute was then considered against the six stopbank alignment options and given a score to show how favourable they were. Finally, a matrix of outcomes was prepared to rank the overall alignments from most favourable to least favourable.

3.1 Guiding Principles

In using an MCA approach there is an implicit assumption that a consensus approach to decision making is desirable. In setting up an MCA exercise it is good practice to ensure that –

- The decision makers, collectively, are adequately briefed on all the relevant issues.
- The attributes represent a balanced coverage of the range of issues of interest/concern to the decision makers, and to the wider community.
- The attributes are, as far as possible, be independent and uniquely defined.
- The scoring scale increases/decreases in the same sense for each attribute, e.g. high value bad – low value good.

It is also good practice to aim for between 4 and 10 different attributes. Too few attributes and all relevant issues may not be adequately covered. Too many attributes and the result may not be definitive because of averaging out any significant differences.

To achieve an unbiased result, the workshop facilitator needs to be wary of the following pitfalls, and may need to adapt the process or approach should they arise –

- Incomplete problem framing – the wrong problem or a missing issue.
- Over reliance on intuition – for efficiency gains to the detriment of objectivity.
- Anchoring on a particular issue – overstating the familiar.
- Maintaining the status quo – we've always done it that way
- Resistance to change – perpetuating sunk costs
- Selective confirming evidence – ignoring information which does not conform with expectation
- Redundant safety factor – applying contingency in the face of uncertainty
- Disproportionate weighting of extreme events – aversion to low probability catastrophic event
- Hidden agendas – manipulation of the process or results to favour a particular view point.

4. Attributes to Compare Alignment Options

4.1 List of Issues – Assembled in 2006

These issues were suggested during the design group workshops held as part of the MCA process and in public consultation:

- a) Residual risk of stop bank failure
- b) Hydraulics of river and floodplain zone (including knock-on effects)
- c) Costs (disruption, construction, maintenance)
- d) Economic benefit (flood protection benefit) – future landuse
- e) Visual impact (security, loss of privacy)
- f) Constructability (including time and staging)
- g) Owner compensation/land purchase
- h) Consenting issues/public acceptance – due process
- i) Loss of amenity
- j) Environmental impacts – short and long term effects
- k) Social issues (impact) – access, amenity, etc
- l) Cultural impacts – (e.g. Possible heritage issues, Maori traditions and beliefs
- m) Benefits and disbenefits to landowners (golf course)
- n) Timeframe to complete works
- o) Sustainability/opportunity cost
- p) Interests of Wellington region

Issue suggested at public meeting (24/05/06):

- q) Decline of house value due to proximity of the stopbank.

Additional issue

- r) Landscape

4.2 Definitions of Issues

The following section describes the definitions of the issues as determined by the 2006 feasibility design team.

- a) Residual risk of stop bank failure – stopbank failure is related to flow velocities and erosion forces so where velocities are high more reliance is placed upon protective armouring and ongoing maintenance. For low velocities, erosion forces are less therefore the risk of failure is reduced during the stopbank's lifetime. Ability to increase the level of protection in the future. All stopbank options have crest levels designed to the same annual exceedence probability flood event.
- b) Hydraulic impacts upstream and downstream of the proposed stopbanks – floodplain hydraulics is based on conveyance, water levels, and storage and these are influenced by bed levels and channel width. Improved conveyance may increase downstream water levels. Reduced conveyance may

increase water levels upstream. Reduced floodplain may increase water levels upstream and downstream.

- c) Costs (disruption, construction, maintenance) – disruption costs relate to the extent and time that normal golfing conditions are affected by construction activity such as machinery and noise, stockpiles and exposed fill batters without grass, reinstatement processes and greens reconstruction. Construction costs relate to earthworks, landscaping, walls, tree working, drainage, compaction, survey, utilities, stormwater pumps, etc. Maintenance costs relate to long term maintenance procedures such as lawn mowing, erosion protection inspections, post-flood inspections and cleanup.
- d) Economic impact from flood protection and future landuse options – benefits include flood protection on land that was prone to flooding, reduced cleanup, reduced erosion, reduced damage to fences, greens, tees, buildings, reduced days lost to golf per event. Land value will increase when flood protection is applied, opportunities for land zone change and resale for purposes other than recreation. Increased value of houses now protected against flood.
- e) Visual Impact (security, loss of privacy) – negative impacts from higher stopbanks include loss of scenery, loss of privacy from people on high ground, loss of security, increased spying from potential wrong doers, poor outlook on to back side of a stopbank.
- f) Construction difficulty (including staging and duration) – workability to build stopbank while satisfying conditions specified by golf courses, residents, resource consents. Ease of operation, good working conditions, good access, good materials, speed of construction, good foundation stability, resistance to water ingress.
- g) Owner compensation/land purchase – compensation to the landowners in order to site proposed stopbank in the desired position.
- h) Consenting issues/public acceptance – due process – the difficulty of mitigating effects of construction and the impacts on the wider community (road closure) and the perception of fairness to affected parties and to wider community who is funding the works. Perception of a fair deal with no party unduly disadvantaged or advantaged. Likelihood of achieving consent.
- i) Loss of amenity – impacts on recreational use of river and river bank (fishing, dog walking, etc.) reduction in sense of wellbeing living, working or playing nearby the stopbank, potential for land use change to affect existing well-being. Currently the stopbank provides children with a safe access route to and from Boulcott School, and Boulcott School uses the stopbank as a safe access route to and from the Hutt River for field trips
- j) Environmental impacts – dust, noise, pollution during short term construction period, effects on bed formation in Hutt River on opposite bank. Short and long term effects on river ecology, sediment movements and deposition.
- k) Social issues/impacts – perceptions of value for money, sense of enhancing a community asset, increased feelings of security from flooding, increased perception of property value, improving traffic and carparking conditions next to Boulcott Golf Course, increased recreational value.
- l) Cultural issues - undue impact on a particular societal group, Forest and Bird's views, Heritage issues, Iwi issues and the right to exercise kaitiakitanga.
- m) Impacts on landowners (Golf courses) - can the stopbank improve the function of the golf club, improve golfing experience, attract membership, reduce maintenance costs, improve clubhouse facilities, increase in value of the land afforded the protection of the stopbank against flood, new options for land use and development, benefits to businesses and residents of improved flood protection.
- n) Timeframe – the shorter the construction duration the better, less disruption to golf clubs, earlier protection to wider Hutt Valley.
- o) Sustainability/opportunity cost – does the option allow flexibility to GWRC in the long term if river circumstances change, does loss of floodplain limit "room to move" and reduce options for future flood protection schemes, will erosion costs become too great to maintain.

- p) Interests of Wellington region – value for money for the work done, saved damage costs in long term, local golf course facilities maintained and enhanced for public, enhanced feelings of flood security, transparent process, solution seen to be consistent with the wider community priorities.
- q) Impacts on neighbouring house values (due to proximity of the stopbank) – perception of a change to existing visual surroundings and outlook over floodplain, with corresponding reduction in sale price of house.
- r) Impacts on Landscape – potential impacts on existing natural character and the perceived naturalness of the neighbourhood.

4.3 Definitions of Proposed Attributes

The Issues above have been amalgamated into the following attributes. Attribute 3c was an additional attribute inserted into the May 2008 MCA process by the group.

1. Project Costs (c,g,m) [Economic]

Construction costs of stopbank including land purchase, compensation costs (net of commercial benefits) to commercial stakeholders (golf clubs, Safeway Storage Ltd, Transpower) for disruption and impacts to activities and general business. Maintenance costs in the future.

2. River Environment Impacts (j) [Environmental]

Long term effects on river ecology, sediment movements and river morphology.

3a. Permanent Impacts on Property Adjoining Stopbank (e,q) [Economic]

Impacts due to proximity of the stopbank such as loss of scenery, loss of privacy, loss of security, poor outlook onto rear of stopbank. Potential negative impacts on property values next to stopbank (assuming flood protection benefits are a given for all alignment options).

3b. Permanent Impacts on Property Upstream/Downstream of Stopbank (b) [Economic]

Impact on top water levels for any given flood flow due to stopbank. Increased flood levels upstream or downstream, or increased velocities and scour. Costs to maintain existing levels of flood protection upstream and increased river protection works downstream of the stopbank (eg: the Belmont community).

3c. Permanent Impacts on Golf Clubs [Social]

Impact on golf clubs resulting from the effects arising from the viability of the clubs should any particular alignment be adopted. Loss of the contribution to the local community in terms of the service and range of amenities provided.

4. Impacts on Local Community Amenity (i) [Social]

Impacts on recreational use of river, riverbank or channel (fishing, walking dogs, picnics, fitness walks). Impacts on sense of well being living, working, travelling or playing nearby the stopbank. Children's safety to and from local schools and to the river bank for educational visits. Impacts include the existing carparking arrangements around Boulcott Street.

5. Temporary Effects of Construction, Timing and Staging (f,n) [Economic]

Net costs associated with constructability (ease of construction and timeframe) while satisfying conditions specified by stakeholders and resource consents. This includes access to and from site, sourcing materials,

reinstatement, and staging of construction. Short term effects of noise, dust, air pollution during construction. Rock and bed or channel works.

6. Regional Impacts (d,h,k,p) [Social]

Increased areas of flood protection for the Hutt Valley. Reduced burden on ratepayers for post-flood clean-up and social disruption. Regional impact on property values resulting from the level of flood protection, including opportunities for land use change. Perception of fairness to affected parties. Perception of a solution that is value for money, that preserves sporting assets, enhances the community's feelings of protection from flood, increased recreational value.

7. Cultural, Iwi and Heritage (l) [Cultural]

Impacts on a particular societal group, Forest and Bird Society's views or any other advocacy organisation's views. Heritage values. Iwi rights to exercise kaitiakitanga.

8. Sustainable River and Flood Management (a,o,r) [Environmental]

Residual risk of stopbank failure. Capacity to increase level of protection in the future, flexibility of future response if river dynamics change. Manageable levels of sustainable river maintenance as part of ongoing flood plain management. Impact of stopbank on the natural character and landscape of the flood plain and river environment.

4.4 Summary of MCA Attributes

The Four Fundamental Attributes are represented in the list of MCA attributes for Boulcott / Hutt Stopbank Feasibility analysis in the following manner:

- Economic – 1, 3a, 3b, 5
- Social – 3c, 4, 6
- Environmental – 2, 8
- Cultural issues – 7.

Another way of grouping the attributes from the GWRC point of view and for simplicity of reporting is:

- Project Costs - 1
- Sustainability and security - 8
- Impacts – 2, 3a, 3b, 3c, 4, 5, 6, 7.

5. Scoring the Attribute against the Alignment Options

5.1 Introduction

In the 2006 MCA process, a wide range of options (27) were assessed by combining sections of the various alignments to form complete stop bank alignments through different viable combinations of the sections. In the current study, six complete routes were studied, and are shown in the plans provided in section 2 above.

After the attributes have been accepted and understood by the MCA group, the process requires a "scoring" stage, followed by a "weightings" stage.

5.2 Assumptions

The following assumptions were made during the workshop discussions:

1. That all options give full and equal flood protection to the wider Hutt community.
2. GWRC may exercise its right to use its land for flood protection purposes and exclude golfing over its land, in particular the land under Boulcott Golf Course.
3. That the benefits of stream and channel works proposed for the Hutt River are common to all options and that the effects of gaining consent to carry out such activities are not to be a differentiating factor in the MCA process, even though the resource consent process required for the river works is likely to be significant in its own right.
4. That land that becomes flood protected by stopbanks, but forces the closure of a golf club because of the stopbanks, will be disposed of by the land owner to their best advantage.
5. When considering Attribute 5 (Temporary Effects of Construction, Staging and Timing), the Green option may involve delaying construction for years while another golf course is developed for a golf club to shift to a new site.
6. When considering the effects of Attribute 3a (Permanent Effects on Property Adjoining the Golf Courses)
 - the Red Option assumes a golf course in the protected land created by the stopbank for the next 30-40 years – either one combined course or two courses
 - the Green Alignment assumes that protected land becomes residential housing
 - the Hutt Blue/Boulcott Green option assumes land protected in Boulcott golf course becomes residential housing
 - the Hutt Green/Boulcott Alternative option assumes land protected in Hutt golf course becomes residential housing
 - Hutt Blue/Boulcott Alternative option and Blue option assumes both golf courses remain but with stopbanks incorporated.

Option Reference	Option	(compensation, construction, net GC costs)	River environmental impacts	Permanent construction impacts on adjoining property	Permanent impacts on upstream/ down stream property	Permanent impacts on golf clubs	Impacts on local community amenity	Temporary construction, timing and staging effects	Regional impacts	Cultural, lwi and heritage issues	Sustainable river and flood management
1	Red – Eng. Option	4	2	5	3	2	1	4	2	3	2
2	Green Option	5	4	1	4	1	5	5	3	4	4
3	Hutt Blue – Boul. Green	5 ^{#1}	4	3	4	2	3	3	4 ^{#4}	4	4 ^{#5}
4	Hutt Green - Boul Alt.	4 ^{#2}	4	2	4	2	4	3	3	4	4
5	Hutt Blue - Boul Alt.	3	4	4	4	4	3	2	4	5	5
6	Blue - Golf Friendly	1	5	3 ^{#3}	5	5	3	1	3	5	5

Abbreviations: Eng. – Engineering, Boul. – Boulcott, Alt. – Alternative

Notes:

“High score is Good” ie preferable.

- #1. Option 3 is significantly cheaper than option 2 but over the range of costs still scores the same.
- #2. A score of 4 was the majority view, at least one participant felt this score could be a 3.
- #3. It was generally felt that this score could be 3 or a 4.
- #4. Possibly 5 if regional preference for the cheaper option compared to option 5
- #5. Could be 5 as sustainability of option 3 similar to options 5 & 6.

5.3 Scoring the Attributes

Alignment Option Scores – Base comparison of options

The following table shows the options scores against each of the 10 attributes obtained at the workshop held on the 21st May 2008. There was some uncertainty expressed in five of the scores as noted below. The effect of these uncertainties was explored through sensitivity analysis as described later in this report.

6. Weighting the Significance of the Attributes

6.1 Workshop Results

The table below summarises the weightings applied to the Attributes during workshops. It can be seen that the weightings of the Attributes in the current MCA process were similar to the weightings agreed by the design team in the first MCA process, 2007, if one allows that addition of Attribute 3c has been balanced by a reduction in weightings from other impacts and attributes.

Table 6-1 : Attribute Weights – Technical Team, Group Viewpoint

Attribute (short label)	Team weightings (2007)	Latest (May 2008)
1. Project Costs	15%	15%
2. River Env. Impact	11%	10%
3a. Impacts - Adjoining Property	9%	11%
3b. Impacts - U/D Property	13%	3%
3c. Impacts - Golf clubs ^{#1}	-	13%
4. Amenity Impacts	11%	10%
5. Construction	6%	7%
6. Regional Impacts	7%	7%
7. Cultural Impacts	11%	10%
8. Floodplain Sustainability	17%	16%
TOTAL	100%	100%

Note #1: New attribute added.

The attribute weightings are summarised in two other ways for comparison: grouped against the “four well beings” as referred to in the Local Government Act (Table 6.2); and grouped to demonstrate the balance of project cost and sustainability against other Impacts (Table 6-3). The numbers beside the Fundamental item or the Attribute Grouping item refers to the Attributes grouped into that summary item. The two groupings illustrate how the MCA attempts to balance the costs of the project against other factors (tangible and intangible) for the purpose of a fair comparison.

Table 6-2 : Attribute Weights – The Four Fundamentals (Well Beings)

Fundamental	Team weightings (2007)	Latest (May 2008)
1. Economic – 1, 3a, 3b, 5	43%	36%
2. Social – 3c, 4, 6	18%	29%
3. Environmental – 2, 8	28%	26%
4. Cultural issues – 7	11%	10%
TOTAL	100%	100%

Table 6-3 : Attribute Weights – GWRC Consolidation of Attributes

Attribute Grouping	Team weightings (2007)	Latest (May 2008)
1. Project Costs – 1	15%	15%
2. Sustainability and Security – 8	17%	16%
3. Impacts - 2,3a,3b,3c,4,5,6,7	68%	69%
TOTAL	100%	100%

7. MCA Result

The Table below gives the overall option scores obtained using the scoring and weighting presented above and is referred to as the 'Base Result' in the following sensitivity test discussions.

Table 7-1 : Alignment Options – Base Case

Alignment Option	Base Case Result	Ranking
Red - Eng Option	2.79	6
Green Option	3.52	4
Hutt Blue – Boulcott Green	3.61	2
Hutt Green - Boulcott Alternative	3.39	5
Hutt Blue - Boulcott Alternative	<u>3.89</u>	1
Blue - Golf Friendly	3.61	2

Option Hutt Blue–Boulcott Alternative gained the highest score (3.89) with the options Hutt Blue – Boulcott Green and Blue–Golf Friendly both scoring next highest (3.61). The difference between these two top scoring options is therefore 0.28.

On the basis of equal weighting, each score point translates to approximately 0.1 in the overall option score and hence the following 'rules of thumb' apply:

- a) Differences between option scores of less than 0.1 are considered insignificant, within the accuracy of the MCA method.
- b) Differences between option scores of greater than 0.2 are considered significant, requiring typically more than three score changes to influence the preferences amongst the options.
- c) Differences between option scores of between 0.1 and 0.2 may or may not be significant, and a sensitivity analysis is required to build confidence in the result.

The difference of 0.28 represents almost a three score point difference, and hence the difference between the highest scoring option and the next highest options is considered to be significant. This suggests that the "Hutt Blue – Boulcott Alternative" option is preferred over "Hutt Blue – Boulcott Green" and "Blue–Golf Friendly" options on the basis of the Multi-criteria assessment approach.

Considering the scoring matrix, the "Hutt Blue – Boulcott Alternative" option scores better than "Hutt Blue – Boulcott Green" option in terms of permanent construction impacts, permanent impacts on the Golf clubs, cultural and sustainability attributes. It scores better than "Blue – Golf Friendly" option in terms of project cost, local amenity issues and temporary construction impacts.

8. Sensitivity Analysis

Having agreed the base scores and weights (referred to as the base results), a number of adjustments were made to the weights at the workshop, to investigate the effect of these changes on the preferences amongst the options.

8.1 Sensitivity of Scores

The effect of the following changes to the scores were also explored to see if these would change the relative preferences for the different options –

Variant 1 Project cost score for "Green" option changed from 5 to 4

Variant 2 Project cost score for "Hutt Green – Boulcott Alternative" changed from 4 to 3

Variant 3 Permanent Construction Impacts on Adjoining Properties score for "Blue – Golf Friendly" from 3 to 4

Variant 4: Regional Impacts option "Hutt Blue – Boulcott Green" changed from 4 to 5

Variant 5: Sustainability attribute "Hutt Blue – Boulcott Green" changed from 4 to 5.

The results of these sensitivity tests are shown in the table below, where the changes in the overall option scores for each variant are compared to the base results. It can be seen that the option "Hutt Blue – Boulcott Alternative" option has the highest score throughout. However, the margin of the preference is reduced for Variants 3, 4 and 5.

Table 8-1 : Variant Options

	Base	Variant 1	Variant 2	Variant 3	Variant 4	Variant 5
Red - Eng Option	2.79	2.79	2.79	2.79	2.79	2.79
Green Option	3.52	3.37	3.52	3.52	3.52	3.52
Hutt Blue - Boul Green	3.61	3.61	3.61	3.61	3.68	3.77
Hutt Green - Boul Alt	3.39	3.39	3.24	3.39	3.39	3.39
Hutt Blue - Boul Alt	3.89	3.89	3.89	3.89	3.89	3.89
Blue - Golf Friendly	3.61	3.61	3.61	3.73	3.61	3.61

As noted above, it would require at least 3 score point changes in the favour of the Hutt Blue - Boulcott Green or the Blue – Golf Friendly options for the top ranking option to change. Further sensitivity testing based on the weightings was carried out to test the robustness of this result.

8.2 Sensitivity of Weightings

8.2.1 Weighting Schemes

A number of weightings profiles were applied to the scores to test sensitivity. The weightings schemes are shown in Table 8-2, and summarised again in Table 8-3 under the GWRC Consolidation of the Attributes.

Tipping Point Test Weightings

The cheapest option is the "Hutt Blue-Boulcott Green" alignment. This option ranked second in the base case MCA. A "Tipping Point" test was applied to discover at what weightings the "Hutt Blue – Boulcott Green" option would become the favoured option. This was achieved by reducing the weightings of all other attributes, apart from project cost, by one decrement at a time until the "Hutt Blue-Boulcott Green" option became the favoured option. During the decremental process, three attributes reached the lowest step weighting of 1 out of 10 and were held at this lowest weighting rather allowed to drop to zero. Non zero weightings were maintained to prevent low weighting attributes from dropping out entirely from the process. Overall results of the sensitivity are test are shown in Table 8-4.

GWRC 2007 Weightings

In September 2007 a weighting scheme was put forward by GWRC to Council to discuss what the Council's expectation of relative weightings was. It is understood that the weighting scheme was generally agreed by Councillors at that time. This weighting scheme, "GWRC 2007", was applied to the MCA results reported here to test the likely outcome using Councillors' weightings. For this test, two variations on the scores were also investigated as follows:

- (a) the scoring of the second least cost option (Green) was given a 5 for Project Cost in the workshop the same as the lowest cost option, as the cost difference was \$0.5 million, and
- (b) the Green option was given a 4 for project cost to reflect the sensitivity to costs in this test.

Overall results of the sensitivity are test are shown in Table 8-4.

FPD 2008 Weightings

The Flood Protection Department of the GWRC provided another weighting scheme to test the sensitivity of the outcomes by weighting the project cost and sustainability attributes high and weighting the other impacts lower. This scheme represents the view of officers of the flood protection department of GWRC (FPD 2008) in June 2008. For this test, the same two variations on the scores were also investigated as follows:

- (a) the scoring of the second least cost option (Green) was given a 5 for Project Cost in the workshop the same as the lowest cost option, as the cost difference was \$0.5 million, and
- (b) the Green option was given a 4 for project cost to reflect the sensitivity to costs in this test.

Overall results of the sensitivity are test are shown in Table 8-4.

Table 8-2 : Table of Weightings Schemes

Attribute (short label)	Base (May 2008)	Tipping Point test %	GWRC 2007 test (a and b) %	FPD 2008 test (a and b) %
1. Project Costs	15%	31.3	40	24
2. River Env. Impact	10%	6.3	10	7.1
3a. Impacts - Adjoining Property	11%	9.4	1.66	7.1
3b. Impacts - U/D Property	3%	3.1	1.66	7.1
3c. Impacts - Golf clubs ^{#1}	13%	12.4	1.66	7.1
4. Amenity Impacts	10%	6.3	10	7.1
5. Construction	7%	3.1	5	4.8
6. Regional Impacts	7%	3.1	10	9.5
7. Cultural Impacts	10%	6.3	5	9.5
8. Floodplain Sustainability	16%	18.7	15	16.7
TOTAL	100%	100%	100%	100%

Table 8-3 : Attribute Sensitivities – GWRC Consolidation of Attributes

Attribute (short label)	Base (May 2008)	Tipping Point test %	GWRC 2007 test (a and b) %	FPD 2008 test (a and b) %
1. Project Costs – 1	14.5%	31.3	40	24
2. Sustainability and Security – 8	16.1%	18.7	15	16.7
3. Impacts - 2,3a,3b,3c,4,5,6,7	69.4%	50	45	59.3
TOTAL	100%	100%	100%	100%

Table 8-4 : Table of Sensitivity Results Due to Weightings Schemes

	Base	Tipping Point Test	GWRC 2007 test (a)	GWRC 2007 test (b)	FPD 2008 test (a)	FPD 2008 test (b)
Red - Eng Option	2.79	3.00	3.00	3.00	2.88	2.88
Green Option	3.52	3.72	4.30	3.90	3.83	3.60
Hutt Blue - Boul Green	3.61	3.88	4.20	4.20	3.90	3.90
Hutt Green - Boul Alt	3.39	3.50	3.75	3.75	3.57	3.57
Hutt Blue - Boul Alt	3.89	3.81	3.60	3.60	3.86	3.86
Blue - Golf Friendly	3.61	3.25	2.70	2.30	3.38	3.38

Note: (a) "Green" and "Hutt Blue – Boulcott Green" options both score 5 for project cost.
 (b) "Green" scores 4 for project cost to reflect \$0.5 million more cost.

8.2.2 Sensitivity Results

It was found that increasing the weighting on project costs above 31%, eliminated the margin of preference for the "Hutt Blue – Boulcott Alternative" option over "Hutt Blue – Boulcott Green" option. With the project cost weighting increased to 40% the two least expensive options became top ranking without a significant difference between them, "Hutt Blue – Boulcott Green" and "Green". In such a case, the least expensive option would become the preferred of the two - "Hutt Blue – Boulcott Green" is \$0.5 million cheaper. However, the preference for the "Hutt Blue – Boulcott Alternative" remains significant when impacts are weighted more heavily. Removing Project Costs from consideration altogether would result in a new highest scoring option; the "Blue – Golf Friendly" option.

As can be seen from the GWRC Consolidation of Attributes table above, the weighting towards impacts was nearly 70% and the project costs weighting was nearly 15% as assessed during the May 2008 workshop, and this produced "Hutt Blue/Boulcott Alternative" option as the highest ranking even though the option is estimated to cost \$2.4million more than the least expensive option. In reality, the weightings balance, as perceived by Councillors and representatives of the wider Greater Wellington community, is likely to have project costs nearer to 30-40% or more in which case the lower cost options will rank as higher options.

8.3 Concluding Comments

The "Hutt Blue – Boulcott Alternative" option is the favoured option from the MCA process reported here. This is a new option introduced following the previous MCA process in 2006 and represents a revision of previous preferred options, with an improvement from the golf clubs' point of view. The analysis here demonstrated that this option is indeed preferred over the previous preference "Hutt Blue-Boulcott Green" but costs an extra \$2.4 million.

The results presented here follow on from work conducted from a number of previous exercises since 2006, each resulting in a further fine tuning of the preferred options, and where appropriate, inclusion of additional variants to the alignment as they were proposed. The MCA process has been applied to the selection of a preferred alignment for the Hutt-Boulcott stop bank using the guiding principles outlined in Section 3 of this report. A great variety of options have been considered based on the wide ranging views of the different stakeholder and affected parties involved. At each stage sensitivity analysis has been performed to demonstrate the robustness of the findings.

The sensitivity analysis of the weightings shows that, given the scoring remains broadly the same, the preferred option is dependent upon the balance of the project costs and other impact attributes. If Project Costs are weighted at 30% to 40% then the least cost options are preferred – "Hutt Blue/Boulcott Green" and "Green" options. Both of these options would result in the closure of at least one golf course. If other Impacts are weighted highly then the preferred option is "Hutt Blue/Boulcott Alternative", which keeps both golf clubs viable, but at an additional cost of \$2.4 million. This demonstrates that it will cost typically \$2.4 million more than the least cost option to maintain two viable golf courses.