Appendix E

Risk Register

Ref	The risk: what can happen and how can it happen	Qualitative Risk Analysis				Risk Priority	Risk Reduction Measures & Treatment Type	How likely is event	No	Best Case	Most Likely	Worst Case	Evaluation Comments	Best Case	Most Likely	Worst Case
		Threat or Opportunity	How likely is the event?	Consequence Rating	What are the consequences of the event?											
2.0	**Category 2 : Cost Risks (Commercial,Legal,Economic, Managerial)**															
2.1	**Project Scope and Estimating**															
2.1.1	Design change / additional scope	**Threat**	Likely	Substantial	Additional work required to meet KCDC requirements	Extreme Threat	VIP Process to manage and agree extent of works	100%		-11,000,000.00	11,000,000.00	70,000,000.00	- (2.5%), 5% and 12.5%	-2.5%	5%	10%
2.1.2	Scope of work for mitigation works to existing expressway is greater than assumed.												No allowance.	EXCLUDED FROM PROJECT	EXCLUDED FROM PROJECT	EXCLUDED FROM PROJECT
2.1.3	Cost escalation over and above 3% typical NZTA allowance. Excluded from SAR.	**Threat**	Quite Common										No allowance.	No change	Say 1% per annum extra.	Say 3% per annum extra.
2.1.4	Measurement risk	**Threat**	Quite Common					100%			2,000,000.00	10,000,000.00	0%, 0.5% and 2%.	0.2%	0.5%	1%
2.1.5	Estimating productivities are incorrect Construction Team (Estimating)) - Increase in cost of materials, plant and labour over predicted levels.	**Threat**	Quite Common	Medium	Escalation beyond predicted levels - TOC not agreed - funding not signed.	Very High Threat	Seek opportunities to reduce costs such as on site prefabrication and	100%			5,000,000.00	30,000,000.00	0.5%, 1%, 5%	Manage with TOC	Some cost escalation but contained within expectations.	Funding not approved.
2.1.6	Delay in securing funding	**Threat**	Quite Common	Medium	Delay to start and increased cost of project	Very High Threat	Keep NZTA aware of risks and consequence									
2.1.7	Additional design and planning work as design effort is different to that assumed in tender.							100%			800,000.00	3,300,000.00	0%, %,2.5%,10% of $33M.			10
3.0	**Category 3 : Cost Risks (Community, Political), Environmental, Land & Property)**															
3.1	**Health and safety**															
3.1.2	Injury / fatality during Phase 1 & 2.	**Threat**	Rare	Medium	Loss of life or serious injury, prosecution, poor image, delay.	Moderate Threat	Phase 1 & 2 H&S Plan Effective traffic management.						No allowance.	PR and H & S risk.	PR and H & S risk.	PR and H & S risk.
3.2	**Environmental**															
3.2.1	Noise, air quality and vibration complaints and general dissatisfaction from stakeholders.	**Threat**	Unusual	Medium	Regional media coverage	High Threat	Design for noise/dust/vibration mitigation. Early modelling.	70%	30%	50,000.00	100,000.00	250,000.00		No change	Cleaning dust from houses and minor compensation.	Minor mitigation works or temporary relocation.
3.2.2	Extent of noise walls between Leinster to Raumati Road changes from the Base Estimate	**Threat**	Unusual	Medium	Cost	High Threat	Design management	30%	70%	650,000.00	1,300,000.00	3,000,000.00	- 10%, 20% or 40% increase. $7M allowed for in Base Estimate. - 7000m2 of precast wall and 2500m2 of timber noise fence.	As Base Estimate	Lower percentage of worse case to be allowed in ML	- 2.5m high noise barrier on west side of expressway, 400m long. - 2.0m high concrete barrier on the west side of the Expressway, just south of Raumati Road, 100m long.
3.2.3	Extent of noise walls between Raumati Road to Kapiti Road changes from the Base Estimate	**Threat**	Unusual	Medium	Cost	High Threat	Design management			Included 3.2.2	Included 3.2.2	Included 3.2.2		As Base Estimate	Lower percentage of worse case to be allowed in ML	- Increase 2m high timber noise boundary fence at Quadrant Heights on West side of expressway (adjacent to distances 5580m to 5700m, 3m high). - Increase 3m high timber noise boundary fence at Milne Avenue on west side of Expressway (adjacent to distances 5800m to 6100m), 4m high. - Noise mitigation to one house 21 Observation Place (insulation, double glazing, ventilation).
3.2.4	Extent of noise walls between Kapiti Road to Mazengarb Road changes from the Base Estimate	**Threat**	Unlikely	Medium	Cost	High Threat	Design management			Included 3.2.2	Included 3.2.2	Included 3.2.2		As Base Estimate	Lower percentage of worse case to be allowed in ML	- Ass 2.0m high timber boundary noise wall to eastern side of expressway. Length approx. 50% of distance from Kapiti Road to Mazengarb Road (750m).
3.2.5	Extent of noise walls between Mazengarb Road to Te Moana Road changes from the Base Estimate	**Threat**	Unusual	Medium	Cost	High Threat	Design management			Included 3.2.2	Included 3.2.2	Included 3.2.2		As Base Estimate	Lower percentage of worse case to be allowed in ML	- Add 2.0m concrete noise barrier on east side of expressway north of Otaihanga Road (800m) - Add 3m high concrete noise barrier on east side of expressway at Puriri Road (300m).
3.2.6	Extent of noise walls between Te Moana to Peka Peka Road changes from the Base Estimate	**Threat**	Unusual	Medium	Cost	High Threat	Design management			Included 3.2.2	Included 3.2.2	Included 3.2.2		As Base Estimate	Lower percentage of worse case to be allowed in ML	- OGPA road surfacing on expressway from just north of Smithfield Road (distance 14000m) to past the two affected properties in End Farm Road (distance 15600m).
3.3	**Cultural**															
3.3.1	Delayed approval because of strong opposition in Waahi Tapu areas	**Threat**	Likely	Major	Time and mitigation	Extreme Threat	Early, active and high level / all level engagement with affected parties.						No allowance.	Included in programme section	Included in programme section	Included in programme section
3.3.2	Delay in getting HPT and Consents to carry out Investigation work	**Threat**	Likely	Major	Add months programme	Extreme Threat	Early engagement with HPT, KCDC and GWRC						No allowance.	Included in programme section	Included in programme section	Included in programme section
~~3.3.3~~	~~Enhance cultural recognition/relationship kaitiaki of waahi tapu~~	~~**Opportunity**~~	~~Likely~~	~~Medium~~	~~Escalated involvement and strong focus on being flexible in ideas to resolve / mitigate possible issues.~~	~~High Opportunity~~	~~Escalated involvement and strong focus - flexibility in ideas to resolve or~~						No allowance.	~~No change~~	~~No change~~	~~Mitigation works required.~~
3.3.4	Archaeological investigations (3 months allowed in programme).	**Threat**	Unlikely	Minor	Add months programme	Moderate Threat	Allow in budget, early liaison with iwi/archaeologist	30%	70%	10,000.00	30,000.00	2,000,000.00	Professional fees and delay.	No change	No change	6 months delay + fees / reports/ treatment of find / slow digging costs
3.4	**Resource Management Act Consents**															
3.4.1	Inability to obtain consents within the programme timeframe.	**Threat**	Unusual	Minor	Construction start date is delayed.	Low Threat	Robust documentation with EPA. Early engagement and dialogue with the EPA (Planning Steering Group)						No allowance.	No change	No change	12 months delay based on start up P & G levels.
3.4.2	Failure to obtain HPT authority as it is a separate process to the Board of Inquiry.	**Threat**	Unusual	Major	Construction start delay.	High Threat	Apply for HPT approval early and get good working relationship with them.						No allowance.	Consents don't impact on BOI timescales.	No change.	Some time delay after BOI decision up to 3 months. Can not start construction works in some areas.
3.4.3	Delay obtaining QE Park land for construction	**Threat**	Unlikely	Medium	Time delay in construction work in the Park	High Threat	Early engagement with DOC and GWRC						No allowance.	Included in programme section	Included in programme section	Included in programme section
3.5	**Land and Property**															
3.5.1	Delays in acquiring property.	**Threat**	Unlikely	Major	Legal process could take up time to resolve	Very High Threat	Prioritise acquisition to meet construction programme and owner needs						No allowance.	No change from allowance included in estimate.	No change	2 years plus to acquire
3.5.2	Additional property requirements as a result of design refinements	**Threat**	Unusual	Major	Media issues and cost	High Threat	Management of design process	30%	70%			5,000,000.00		No change from allowance included in estimate.	No change	$5 million.
4.0	**Category 4 : Cost Risks (Site Conditions, Engineering, Services, Natural Events)**															
4.1	**Ground Improvements / Geotechnical / Earthworks**															
4.1.1	Groundwater levels are different than assumed due to limited available data.	**Threat**			Increase in the extent of liquefaction.								No allowance as attenuation included in drainage Base Estimate.	WHAT IS THE IMPLICATION?		
4.1.3	Potential long term poor performance of expressway associated with preload and surcharge not agreed formally with NZTA.	**Threat**											No allowance.	REPUTATIONAL RISK OUTSIDE THE SCOPE OF THE PROJECT	REPUTATIONAL RISK OUTSIDE THE SCOPE OF THE PROJECT	REPUTATIONAL RISK OUTSIDE THE SCOPE OF THE PROJECT
4.2	**Ground Improvements (Peat)**													**SPLIT PROJECT INTO SECTIONS AND WEIGHT THE INCREASES**		
4.2.1	Increased volume of peat removed as need to dig deeper.	**Threat**	Quite Common					50%	50%		2,200,000.00	6,600,000.00	Peat Base Estimate 1,300,000m3 @ $7/m3 and replace with sand @ $9/m3.	How many more m3 as a % NO change	How many more m3 as a % 10% increase as greater depth.	How many more m3 as a %. 30% increase depth.
4.2.2	Additional unforeseen peat???	**Threat**	Unlikely										Included in 4.2.1.	No change and could be less peat.	No change	10% increase.
4.2.3	Increase in preload/ surcharge height and volume of settlement requiring additional fill i.e. settles more than anticipated and requires additional import.	**Threat**	Quite Common					30%	70%		2,100,000.00	8,400,000.00	- Preload extent is 6km at South end and 2.5km at North end with 2.5m surcharge. - 5% to 10% additional surcharge based on 1,200,000m3 of preload and embankment material. 0%, 5% 20%,	Reduction in time by 3 months and less fill required.	No change.	How many more m3 as a %. WHAT IS PLAN B IF PRELOAD DURATION NOT SUITABLE FOR PROGRAMME. X 2 THE COST FOR ALTERNATIVE?????? EXTENT OF POTENTIAL AREAS ???? WC is dig out and replace and load transfer structures. ADD 6 months to programme and additional fill required to fill 200mm / 300mm across 25%.
4.2.4	Settles less than expected resulting in increased cut to waste.	**Opportunity**	Unlikely										Included in 4.2.3.	3 month saving and can use fill elsewhere? 25% of overall route.	No change	WC is dig out and replace and load transfer structures. ADD 3 months to programme and additional fill required to fill 200mm / 300mm across 25%.
4.2.5	Peat dig out and replace requires temporary support due to proximity of properties etc 6 No locations. near Kapiti. DAVE HOFFMAN. GREATER THAN ASSUMED.	**Threat**	Likely					30%	70%		500,000.00	3,000,000.00	Base Estimate includes an allowance of $300,000.	How big could temp works be over current allowance e.g. sheet pile adjacent to houses. HAVE WE MADE ALLOWANCE FOR THIS	How big could temp works be over current allowance e.g. sheet pile adjacent to houses. HAVE WE MADE ALLOWANCE FOR THIS	How big could temp works be over current allowance e.g. sheet pile adjacent to houses. HAVE WE MADE ALLOWANCE FOR THIS
4.2.6	80 disposal / 20% peat reuse ration may change.	**Threat**	Likely										No allowance.	60/40	No change	100% disposal.
4.3	**Ground Improvements (Seismic)**															
4.3.1	Further soil/ structural interaction modelling requires additional stone columns/ change in ground improvement structural form (e.g. shear piles)	**Threat**	Quite Common					50%	50%	-1,500,000.00	1,500,000.00	6,000,000.00	- Base Estimate has $30M allowance for stone columns. - (5%), 5%, 20% increase.	50km of piles allowed for therefore what percentage increase. 10% reduction	50km of piles allowed for therefore what percentage increase. No change.	50km of piles allowed for therefore what percentage increase. Change to piles at abutments along entire alignment CFA piles or greater footprint of stone columns (say 20% increase in quantity around piers).
4.3.2	Further investigations identify deeper and more continuous liquefiable layers requiring increased treatment extent. Deeper stone columns required.	**Threat**	Quite Common					30%	70%	-6,000,000.00		9,000,000.00	'- Base Estimate has $30M allowance for stone columns.	Reduce length by 20%.	No change.	30% increase
4.3.3	Cut slopes may require stability measures over and above current design allowance adjacent to over bridges being constructed next to sand dunes at Ngarara. SOIL NAILING MAY BE REQUIRED.	**Threat**	Likely										Allowance to be made in Base Estimare.			

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		Threat or Opportunity	How likely is the event?	Consequence Rating	What are the consequences of the event?											
4.3.4	Proposed stone column solution is not suitable in some locations due to affects of vibration and lack of water supply or other issues.	**Threat**	Quite Common										No allowance.	No change	2 key abutments at Southern Waikania and one side Romati and others. SAY 2 ABUTMENTS ARE AFFECTED.	6 abutments affected.
4.3.5	Peer review results in additional mitigation measures and / or delay in reaching agreement.	**Threat**	Quite Common										No allowance.	NO change	No change.	+ 3 month while reach agreement. Say 5% MAX.
4.3	**Earthworks**															
4.3.1	Unforeseen ground conditions due to limited geotechnical investigation and data in areas along the alignment.	**Threat**	Quite Common	Substantial	Increased cost and time.	Extreme Threat	Further investigation. Allow for conservative improvements						No allowance.	Included in other risk items.	Included in other risk items.	Included in other risk items.
4.3.2	Increase in seismic performance required following Canterbury Earthquakes	**Threat**	Unusual	Substantial	Increased cost and time.	Very High Threat	Talk to VAC early on this specific topic.						No allowance.	Included above in GI	Included above in GI	Included above in GI
4.3.3	Increase in contaminated material requiring landfill disposal	**Threat**	Quite Common	Medium	Environmental issues. Poor stakeholder relationships. Health and safety issues.	Very High Threat	Investigations need to be undertaken to establish contamination levels. Establish management plan. Appropriate design to be adopted.	20%	80%		300,000.00	1,500,000.00		No change.		
4.3.4	Insufficient cut to fill materials leads to increase in imported material	**Threat**	Quite Common	Major	Increased cost of fill materials and disposal.	Very High Threat	Further geotechnical investigations required.	30%	70%		800,000.00	2,000,000.00	- 5% allowance for lose of material. - Total cost $40M. - 0%, 2%, 5%.	No change.	No change	10% increase
4.3.5	Local sources of imported fill unsecured/ insufficient, requiring imported fill materials from other sources	**Threat**	Unusual					10%	90%		1,000,000.00	3,000,000.00	- 1,000,000m3 @ $40/m3.	No change.	No change	Additional $10/m3.
4.2.6	Suitability and capacity of KCDC landfill site with regard to disposal of excess peat is different than assumed in base estimate	**Threat**	Unusual		Increased cost and time.	#N/A		50%	50%		1,000,000.00	2,500,000.00	Allowances in most likely and worse case for oxidation pond mitigation works.	Landfill can accommodate all surplus peat over 100,000m3. Take all material to adjacent to quarry????	300,000m3 of peat will be taken to the landfill site and the remaining will be taken to the old oxidation ponds, 11km from the landfill site.	All of the surplus peat has to be taken to the oxidation ponds 11km form the landfill site. What is development cost of oxidation ponds????? What is plan C??? Planting $2.172 paul leman.
~~4.2.7~~	~~Scope of clay capping of landfill and gas collection system is different than assumed in the Base Estimate~~	~~**Threat**~~			~~Increased cost and time.~~									~~Landfill will be capped with 300mm of clay with no gas collection system required.~~	~~Landfill will be capped with 300mm of clay with a minimal gas collection and venting system required.~~	~~Landfill will be capped with 300mm of clay with an extensive gas collection and venting system required. HOW MUCH MORE EXPENSIVE THAT MOST LIKELY x 3?????~~
4.4	**Stormwater**															
4.4.1	Waterway, flood, culvert requirements are different and more extensive to those assumed in the design e.g. fish passage and environmental issues.	**Threat**	Unlikely	Major	Need bridges at larger culvert crossings	Very High Threat	Early discussions with KCDC and Greater Wellington Regional Council.	30%	70%	-600,000.00	600,000.00	1,200,000.00	- 12M allowed in Base Estimate for culverts. - Total drainage estimate $37.5M. - Additional cost (-5%), 5%, 10%.	No change.	Percentage of worse case.	Additional width of say 0.5m increase in box culvert or increase in pipe size by one size. To 60% of culverts. Increase (one standard pipe size) required to those culverts with the stream bed through the invert as listed in the schedule.
4.4.2	Excessive settlement of smaller culverts over and above assumed levels. Treatment of large culverts have been ground improved areas.	**Threat**	Quite Common	Medium	Additional cost Time delays. Excessive post settlement remedial works.	Very High Threat	Geotechnical investigation to confirm ground conditions. Make allowance in TOC.	50%	50%		1,000,000.00	3,000,000.00	- % allowance for relaying base on $12M base estimate. - 0%, 12.5%, 25%.	Method works for all cases so no relaying of culverts needed or simpler method used.	WHAT IS THE CURRENT DESIGN PROPOSAL??? Method found not to be appropriate for some (say 20%) of pipe culverts leading to use of temporary culverts or sacrificial pipe and then need to be removed and relayed / culvert installed.	Relay all pipe culverts in preload areas or alternative method used for all.
4.4.3	GWRC require the Te Moana floodway to be bigger than allowed for in estimate.	**Threat**	Unlikely	Major	Change in bridge structure	Very High Threat	Design management	10%	90%			250,000.00	Additional span worse case.	No change	No change	Increase in span by 1 span.
4.4.4	Change in South Waikanae River bank works to that allowed for in design. Currently 1500mm super T at max span limit.	**Threat**	Unusual	Major	Change to structure of river upstream	High Threat	Design management	70%	30%		3,600,000.00	3,600,000.00		GWRC / BoI accept modified alignment. No change.	Minor additional approach works e.g. scour / rip rap etc but increased consenting costs. Peer review to cost M2PP of $15,000.	Longer span required of say 4 No 45m spans with 3 piers with steel I girder superstructure.
4.4.5	Puriri Road offset storage scope of work changes. Upgrade stormwater pump station	**Threat**	Unlikely					10%	90%			500,000.00		Can provide mitigation with minimal additional works. Upgrade small length of pipe and more wetland excavation. SAVING SMALL	As shown on drawings. Excluding pump station. No change.	Need to upgrade pump station and pipework (1m3/s low head pump). $500,000 all up.
4.4.6	Offset flood storage greater than assumed in design pre BOI Groundwater drainage measures required but not planned for i.e. drain down with property settlement effects, storage area increases on plan due to lack of depth from high water table..	**Threat**	Quite Common										Included in 2.1.1	Include in design creep risk above.	Include in design creep risk above.	Include in design creep risk above.
4.4.7	Scope / design creep relating to local road network drainage measures.	**Threat**	Quite Common										Included in 2.1.1	Include in design creep risk above.	Include in design creep risk above.	Include in design creep risk above.
4.4.8	May need to increase road height between Mazengarb and Otaihunga.	**Threat**	Likely					50%	50%	40,000.00	60,000.00	80,000.00	30m typical embankment width x 600m x .5	allow 600m approx x .5m	allow 600m approx x .75m	allow 600m approx x 1m
4.5	**Pavements**															
4.5.1	Premature pavement failure during operation.	**Threat**	Rare	Major	Poor media coverage. Poor PR. Additional cost of repairs.	High Threat	Geotechnical investigation. Adoption of suitable design for ground conditions.						No allowance.	Outside TOC.	Outside TOC.	Outside TOC.
4.5.2	Pavement profile changes as a result of worse than expected ground conditions in peat and preload areas if areas not settled fully. Refer Principles Requirements.	**Threat**	Unlikely										No allowance. Included in 4.1 Ground Improvements.	Better than assumed ground conditions and pavement thickness can be reduced. HOW THINNER. No change as only 400mm thick.	Pavement remains as currently designed. Resolved prior to finalisation of PR. No change.	Deeper by 100mm by increasing sub base and increased % of lime say 3%.
~~4.5.3~~	~~Cycleway surfacing changes from chipseal to 25mm asphalt. IS THIS A RISK IF IN MINIMUM REQUIREMENTS????~~	~~**Threat**~~												~~Remains chipseal~~	~~if this is true why not price ac in toc??????? Changes to asphalt. WHAT IS IN THE MINIMUM REQUIREMENTS????? KAPITI BLUE REQUIREMENT????~~	~~if this is true why not price ac in toc??????? Changes to asphalt.~~
4.5.4	Extent of upgrade works on locals roads increases.	**Threat**	Quite Common					30%	70%		900,000.00	2,000,000.00	0%, 15% and 30%	Remains as designed.	15% to 20% increase in cost.	30% increase in cost.
4.5.5	OGPA surfacing extended to the north as a noise mitigation measure	**Threat**	Unlikely					5%	95%			450,000.00		Remains as designed.	Remains as designed.	OGPA surfacing extended to Ch 15600m say 1km.
4.5.6	Greater settlement than predicted on Raumati straight northbound lanes.	**Threat**	Unlikely					20%	80%	-1,000,000.00		1,000,000.00	Additional rip and remake number -1 No. Zero +1.	Only 1 rip and make or shape correction with asphalt.	As per assumption to rip and remake.	1 No. rip and remake operations are required.
4.5.7	Settlement of southbound Raumati Straight due to draw down from preloading required for new expressway.	**Threat**	Unlikely					10%	90%		100,000.00	1,000,000.00	- Rip and remake 0, 10% and 100% of total area = 18,000m2.	No change	Localised relevelling to 10% of total area.	1 No. reshape correction for entire width x 2km length and remake operations are required.
4.6	**Kerbing**															
4.6.1	Extent of kerb and channel required is greater than assumed in Base Estimate	**Threat**	Unlikely					20%	80%		100,000.00	250,000.00	0%, 20%, 50% x $500K	Less K & C than shown.	Close to what has been indicated.	A lot more kerbing required.
4.6.2	Design of traffic island change from that allowed for in the Base Estimate	**Threat**	Unlikely										No allowance. Included in 2.1.1.	Concrete filled islands required.	Concrete filled islands required.	Some landscaped features added to islands.
4.7	**Structures**															
4.7.1	Increase in requirement for form and architectural treatment of bridges	**Threat**	Likely	Major	Additional cost of urban design requirements, Breakdown of relationship with KCDC if treatments not acceptable.	Extreme Threat	Development of design philosophy for project with KCDC.	30%	70%		2,500,000.00	15,000,000.00	$70M total bridge cost. 0%, 5% and 15%	No change	5% increase in cost.	15% to 20% increase in bridge cost.
4.7.2	~~Requirement by KCDC for additional structures~~	~~**Threat**~~	~~Likely~~	~~Major~~	~~Increase costs and construction time~~	~~Extreme Threat~~	~~Early engagement with KCDC~~							~~No change.~~	~~No change.~~	
4.7.3	Pile size / lengths change seismic issues or ground conditions.	**Threat**	Likely					30%	70%	-2,100,000.00		4,200,000.00	-10%, 0%, 20%. $21M in piles and pile sleeves.	10% reduction from design.	No change.	20% increase from design.
~~4.7.4~~	~~Pile size changes seismic issues or ground conditions.~~	~~**Threat**~~	~~Likely~~											~~Piles reduce by 150mm~~	~~No change.~~	~~Increase from 2.1m diameter to 2.3m diameter.~~
4.7.5	Te Moana bridge changes in length due to hydraulic requirements.	**Threat**	Likely										No allowance. Included in 4.4.3	Length reduced by 10m	No change.	Increases by 30m i.e. 1 span.
4.7.6	Waikanae River bridge changes in length due to land requirements.	**Threat**	Unusual										No allowance. Included in 4.4.4	No change	No change.	2 extra 35M spans
4.8	**Retaining Walls**															
4.8.1	Specific retaining walls are required at Waikanae to support area adjacent to crescent dune/ P Grace land. Substantial walls, with retained heights in order of 20m required.	**Threat**	Unusual										Included in 4.8.2 below.	No change	No change	Required to purchase greater extent of adjacent properties.
4.8.2	Size, extent and type of retaining walls increase.	**Threat**	Quite Common					50%	50%	500,000.00	2,000,000.00	10,000,000.00	- Only $5M included in Base Estimate. - 10%, 30%, 100%.			
4.9	**Traffic Services**															
4.9.1	Wire rope median barrier replaced with concrete barrier	**Threat**	Rare					10%	90%			4,400,000.00	- Barriers $4.4M - Change 30% of length x 3 times the value to change guardrail to concrete for worse case.	Remains as designed.	Remains as designed.	Very unlikely but change to concrete median barrier required.
4.9.2	~~Length of barrier required for noise mitigation increases~~	~~**Threat**~~												~~Refer Environmental section.~~	~~Refer Environmental section.~~	~~Refer Environmental section.~~
4.9.3	The 2km of W section barrier allowance for miscellaneous protection within the clear zone is insufficient.	**Threat**	Quite Common										Included in 4.9.1 and 2.1.1.	None of the 2km of W section is required.	Approximately 1.5km of W section barrier is required.	Additional 3km per side of W section is required.
4.9.4	Signage on local road network need to be replaced to reflect the change in SH1 to expressway. This is not been design as yet.	**Threat**	Quite Common										No allowance. Included 2.1.1.	See pavement local road risk allowances above	See pavement local road risk allowances above	See pavement local road risk allowances above
4.9.5	Only Kapiti interchange to be signalised. Te Moana may well be required to be signalised.	**Threat**	Unusual										No allowance. Included 2.1.1.	Only Kapiti signalised as included in the Base Estimate.	Only Kapiti signalised as included in the Base Estimate.	Te Moana and Kapiti to be signalised.

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		Threat or Opportunity	How likely is the event?	Consequence Rating	What are the consequences of the event?											
4.9.6	Intersection at Kapiti operates independent of other intersection i.e. no SCATS link included in Base Estimate.	**Threat**	Quite Common										No allowance. Included 2.1.1.	No linkage.	No linkage. WHAT IS THE PROBABILITY THAT SCATS IS REQUIRED.	SCATS linkage required.
~~4.9.7~~	~~No outreach arms allowed for in Base Estimate and design.~~	~~**Threat**~~	~~Quite Common~~										~~No allowance. Included 2.1.1.~~	~~No outreach arms required.~~	~~No outreach arms required.~~	~~2 outreach arms required if visibility is a problem.~~
4.10	**ITS**															
~~4.10.1~~	~~The number of cameras at each interchange reduced from the number allowed for in the Base Estimate.~~	~~**Threat**~~	~~Quite Common~~											~~Reduce number of cameras to 2 at each interchange (8 instead of 14 cameras).~~	~~As shown on drawings with no change.~~	~~As shown on drawings with no change.~~
4.1	**Street lighting**															
4.11.1	Scope of work for street lighting increases from that included for in Base Estimate	**Threat**	Unlikely					20%	80%		100,000.00	200,000.00	- Base estimate $2M. - 0%, 5, 10%.	No change	Additional 5% in light quantities.	- HPS lights replaced with LED's (e.g. Ruud Beta LED luminaires). - Street lighting extended to cover full expressway length. Add for lighting and cabling etc. both sides of expressway.
4.12	**Fencing**															
4.12.1	Extent of boundary fencing changes from that assumed in Base Estimate	**Threat**	Unlikely					20%	80%		240,000.00	480,000.00	- 0%, 10% ,20% - 6km in estimate worth $2.4M	As shown on design drawings.	As shown on design drawings.	An additional 20% length of boundary fence and stock fence.
4.1	**Roading Design**															
~~4.13.1~~	~~Wrong traffic demands assumed as basis for project design.~~	~~**Threat**~~	~~Unusual~~	~~Major~~	~~Change in traffic signal requirements. Change to interchange layouts.~~	~~High Threat~~	~~Sensitivity testing. Robust peer reviews.~~									
4.13.2	Safety Audit leads to increase in scope	**Threat**	Unlikely	Medium	Cost	High Threat	Early engagement with Safety team						No allowance included in 2.1.1.	No change.	No change	5% additional cost of each interchange???????
4.13.3	Additional accommodation works	**Threat**	Quite Common	Medium	Cost	Very High Threat	Early contractor involvement	30%	70%		200,000.00	600,000.00	- Base estimate $2M. - 0%, 10% and 30%.	No change	10% increase in cost	30% increase in cost
4.14	**Construction Risks**															
~~4.14.1~~	~~Serious Injury during construction.~~	~~**Threat**~~	~~Unusual~~	~~Medium~~	~~Loss of life or serious injury. Prosecution. Poor image. Delay.~~	~~High Threat~~	~~Safety in design philosophy. Good Alliance H & S systems set up and utilised.~~							~~NO ALLOWANCE IN TOC~~	~~NO ALLOWANCE IN TOC~~	~~NO ALLOWANCE IN TOC~~
4.14.2	Settlement effects due to groundwater lowering result in cut off walls/ additional land take or repairs to buildings and properties	**Threat**	Quite Common	Medium	Negative environmental affects Poor image Poor relationship with stakeholders. Additional costs to mitigate affects or repair damaged properties. Consenting issues in regard to adhering to conditions of consents.	Very High Threat	Good site management. Baseline monitoring during construction phase. Pre-construction building surveys and monitoring during construction.						No allowance. Included in 4.1 Ground Improvements.	See earthworks / GI risks.	See earthworks / GI risks.	See earthworks / GI risks.
4.14.3	Excessive pollution levels due to dust/ airborne particulates over and above consent conditions during construction phase.	**Threat**	Quite Common	Medium	Abatement notice Time delay. Change in construction methodology. Increased cost. Environment Negative image.	Very High Threat	Additional dust control measures allowed for in construction methodology.	25%	75%		500,000.00	2,000,000.00	Allow 0m, 500m, 1000m wind break type fence @ $100/m.	No change.	Additional mitigation measures.	Additional mitigation measures.
4.14.4	Traffic management is more extensive than assumed.	**Threat**	Unlikely	Medium	Poor media coverage	High Threat	Liaison between traffic modelling , KCDC requirements and construction methodology.	25%	75%		200,000.00	800,000.00	- $8.5M of which $4M is Ruamati Straight. - 0%, 5%, 20%	No change.	+5% increase	+20% increase
~~4.14.5~~	~~Early opening of Kapiti Road to Te Moana~~	~~**Opportunity**~~	~~Likely~~	~~Medium~~	~~Good media coverage~~	~~High Opportunity~~								~~No change.~~	~~No change.~~	~~No change.~~
4.14.6																
4.15	**Services**															
	WHICH OF THE CONSEQUENCES SHOULD WE ALLOW FOR IN THE BASE ESTIMATE AND WHICH IN CONTINGENCY AS LESS LIKELY.														**THIS COLUMN INCLUDED IN THE BASE ESTIMATE**	
4.15.1	Vector Gas scope of work changes from scope included in design and Base Estimate	**Threat**	Quite Common					30%	70%	850,000.00	1,700,000.00	5,100,000.00	- Total Services $17M. - 5%, 10% , 30%. Increase on total.	The Vector Gas Transmission pipe can be installed along the bottom of the expressway embankment on the Eastern side and the area where the pipe is not effected by the expressway can be joined to (i.e. saving approx. 300m of pipe replacement).	The Vector Gas transmission pipe can be installed along the bottom of the expressway embankment.	The pipe is unable to follow the expressway alignment (due to the constraints in the vicinity) and a much longer route is required and hence much higher cost ???m.
4.15.2	Scope relating to the Vector Gas Delivery point is different than assumed in Base Estimate.	**Threat**	Quite Common										Included 4.15.1	The Vector Gas Delivery Point Station does not require relocation.	The Vector Gas Delivery Point Station requires relocation and can be relocated 100m to 300m from the existing location (i.e. either north or south of the river)..	The Vector Gas Delivery Point Station requires relocation to a location not near the existing location (requiring more distribution pipe to link between existing and new location.).
4.15.3	Unforeseen work required to raise Transpower towers. PROBABILITY????	**Threat**	Unlikely										Included 4.15.1	One Transpower tower requires raising.	Two Transpower tower require raising and two require relocating.	Two Transpower tower requires raising and more than two require relocating.
4.15.4	Scope of work included in utility company prices are not correct.	**Threat**	Likely										Included 4.15.1	Services providers may have made a contingency for longer lengths of relocation.	Services providers carried out costing based on relocating services for the road alignment width only - this does not include for swales and cycleway. Potentially some of the relocations will require longer pipe lengths than estimated.	The larger width could take in extra services e.g. cabinets etc. which would increase the cost.
4.15.5	Scope of works assumed by utility companies for relocating services at bridge abutments are incorrect.	**Threat**	Likely										Included 4.15.1	The assumptions made regarding which services will require relocations due to the location of bridge abutments were over conservative.	The assumptions made regarding which services will require relocations due to the location of bridge abutments are OK with some minor wins and losses.	More relocations of services are required than was originally assumed.
4.15.6	Te Moana KCDC water supply bore may need to be relocated.	**Threat**	Quite Common										Included 4.15.1	Te Moana Road interchange can be designed to avoid the need to relocate the KCDC water supply bore.	KCDC water supply bore at Te Moana Road Interchange requires relocation.	Bore requires relocation and there are difficulties in finding a new location.
4.15.7	Unforeseen utility services is encountered. Assume smaller services as large identified.	**Threat**	Quite Common										Included 4.15.1	All services have been accounted for.	A few service private connection relocations have been omitted (e.g. possibly water connection to properties with new accessway off Otaihanga Road).	A major service has been overlooked.
4.15.8	Stormwater design results in the requirement for unplanned services relocations. Particularly on local roads.	**Threat**	Quite Common										Included 4.15.1	No extra services require relocating for the new stormwater infrastructure.	Proposed stormwater designs require some further services relocations e.g. telecom on eastern side of the expressway south of Poplar Avenue.	Further services relocation at both ends of the expressway where it lies into the existing SH1 and at interchanges.
4.15.9	Scope of power cables increases	**Threat**	Quite Common										Included 4.15.1	A case is put forward defending the replacement of only the cables under the expressway.	Relocating some services could require long lengths of cable to minimise the number of joints in the systems. Note this a general risk that applies whenever electrical and communications cables are joined.	A service provider insisting on very long lengths of cable replacement to minimise joints.
4.15.10	~~Electrical cable between Sheffield Street and Makarini Street relocations works is greater than assumed.~~	~~**Threat**~~												~~Cable ok to cross the expressway in it's current location.~~	~~Requires a relocation to new crossing point 150m from existing.~~	~~Cables need to be relocated a greater distance from the existing.~~
4.15.11	New accessway design at Smithfield Street greater than assumed.	**Threat**	Quite Common										Included 4.15.1	Design does not affect the deep wastewater gravity sewer.	Mildly affects the deep wastewater gravity sewer requiring one manhole to be raised to the new fill level.	Greatly affects the wastewater gravity sewer requiring further upgrading / relocation of pipe.
4.15.12	Materials cost fluctuation greater than assumed.	**Threat**	Quite Common										Included 4.15.1	Refer above	Refer above	Refer above
4.16	**Landscaping**														**THIS COLUMN INCLUDED IN THE LANDSCAPING BASE ESTIMATE**	
4.16.1	Rate of establishment of wetland planting is different than anticipated.	**Threat**	Unlikely					25%	75%	-2,000,000.00	1,000,000.00	4,000,000.00	- Total Landscaping in Base Estimate $21.6M of planting. - (10%), 5%, 20% against total value.	High. 80% survival and low weed infestation. Established in 2 years.	70% survival with some weed infestation. 3 year to establish.	30% survival, high weed infestation. 5 years to establish with lots of replanting.
4.16.2	Plant are not supplied as programmed and are of poor quality.	**Threat**	Unlikely										Included 4.16.1.	All plants supplied on time and of high quality.	85% supplied on time with some replacement required.	60% supplied on time with some replacement required.
4.16.3	Community pressure leads to the requirement for a larger number of large grade trees and associated planting and maintenance costs.	**Threat**	Unlikely										Included 4.16.1.	Planting as per design with no change.	Limited requirement for large trees at key places such as Te Moana and Kapiti intersections.	Requirement for large trees at several places.
4.16.4	Erosion of swales before planting is consolidated.	**Threat**	Unusual										Included 4.16.1.	No erosion, all swales established as planned.	Minor erosion in places. Recontouring, replanting required in isolated places. Reworking of outlet erosion areas.	Significant erosion in places, recontouring, replanting and geotextile reinforcing required on long sections of swale. Reworking of outlet erosion areas.
4.16.5	Failure of cut and fill faces requiring recontouring and replanting.	**Threat**	Unlikely										Included 4.16.1.	No failure of faces.	Minor failure of faces.	Significant failure.
4.16.6	Flood storage areas. Final depths of excavations, groundwater level / presence of permanent water / dampness of ground currently unknown.	**Threat**	Unusual										No allowance as included in Stormwater Drainage.	Final ground conditions suitable to support pasture species and vegetation managed through grazing, wetland species colonise naturally. **Refer 4.4.6**	30% flood storage areas need to be planted with wetland species.	Final hydrology not suitable for grassing / grazing whole area needs to be planted with wetland planting. Seasonal changes to water levels affecting plant establishment.
4.16.7	Mitigation and ecological off set measures by GWRC / DOC for streams, wetlands, rivers and QE Park.	**Threat**	Quite Common										Included 4.16.1.	Planting requirements as per design.	Planting requirements 20% more than design.	Planting requirements far exceed design. Unlikely.

Ref	The risk: what can happen and how can it happen	Qualitative Risk Analysis				Risk Priority	Risk Reduction Measures & Treatment Type	How likely is event	No	Best Case	Most Likely	Worst Case	Evaluation Comments	Best Case	Most Likely	Worst Case
		Threat or Opportunity	How likely is the event?	Consequence Rating	What are the consequences of the event?											
4.16.8	~~Takemore Trust mitigation requirements.~~	~~Threat~~												~~No change.~~	~~Takemore Trust require offset / compensation planting beyond designation.~~	~~Takemore Trust require significant offset / compensatory planting and other landscaping mitigation beyond designation.~~
4.16.9	~~Planting on private property outside designation.~~	~~Threat~~												~~No change.~~	~~Requirement for planting as mitigation for visual character, amenity and ecological offsetting QE Park on some properties.~~	~~Requirement for significant planting as mitigation for visual character, amenity and ecological offsetting QE Park on some properties.~~
4.16.10	Retaining existing vegetation less than assumed.	Threat	Quite Common										Included 4.16.1.	Can retain more than assumed.	No change.	Very little retained resulting in more new planting.
~~4.17~~	**Urban Design**															
4.17.1	Cycleway pedestrian bridges scope of work increases.	Threat	Quite Common										No allowance as included in 2.1.1.	Extent with estimate allowance	Some minor cost increase.	Exceed cost allowances.
4.17.2	~~El Rancho tunnel scope of works different than assumed.~~	~~Threat~~												~~Access via floodway to eliminate tunnel and cost of structure.~~	~~Floodway acceptable but cost to mitigate loss of connection in landscaping, rehabilitation or other on site work.~~	~~Can not agree on floodway access and tunnel option required but with larger space.~~
4.17.3	~~Bridge and abutment urban design extent changes from assumed in estimate~~	~~Threat~~												~~No change.~~	~~No change.~~	~~Exceed budget.~~
4.17.4	Urban design at major interchanges changes from scope assumed in design.	Threat	Quite Common										No allowance as included in structures 4.7.1.	No change	No change.	Increased cost to satisfy all parties around wall treatments, pedestrian and cycleway environment. Allow 10% increase in urban design in general.
~~4.18~~	**Preliminary and General Costs and Programme**															
4.18.1	Theft and/or vandalism during construction	Threat	Quite Common					50%	50%	50,000.00	100,000.00	200,000.00		No additional cost.		
~~4.18.2~~	~~Workforce commitment~~	~~Threat~~	~~Unlikely~~													
4.18.3	Force Majeure	Threat	Rare					10%	90%			50,000,000.00	- Reconstruct part of the project. - Alliance risk. - Allow 10% of project as rebuild as worse case. - 0%, 1% and 10%			
~~4.18.4~~	~~Industrial relations~~	~~Threat~~	~~Unusual~~													
~~4.18.5~~	~~Resource availability is limited.~~	~~Threat~~	~~Quite Common~~	~~Major~~	~~Delay in completing work~~	~~Very High - Threat~~	~~Early planning and warnings~~							~~No change~~	~~No change~~	~~3 months delay~~
4.18.6	Adverse weather or preload duration delays greater than programmed allowance.	Threat	Unusual					50%	50%	-3,600,000.00	3,600,000.00	21,600,000.00	- $1.8M P & G per month. - 0, 2, 12 months delay.	No change	4 months delay	6 months delay
4.18.7	Uninsured event or deductables greater than bid allowance.							25%	75%		250,000.00	500,000.00	- Additional 2 No. deductables @ $250,000 each.			
~~4.18.8~~	~~Unforeseen ground conditions due to limited geotechnical investigation and data in areas along the alignment. Increase in undercuts and ground improvements.~~	~~Threat~~	~~Quite Common~~											~~No change~~	~~3 months delay~~	~~12 months delay~~
4.18.9	~~Precast bridge units~~	~~Threat~~												~~-2 months~~	~~-1 month~~	~~No change~~

Date of Risk Review: 28 July 2011

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Compiled by: Stephen Wright

Date: 28 July 2011

[1] The following colours are used to detail risk categories:

Total