WAKA KOTAHI NZ TRANSPORT AGENCY
SH1 WELLINGTON CORRIDOR UPGRADES
BUDGET ESTIMATES

12 June 2024

CONTENTS

APPENDIX

Revision history

Revision Number	Revision	Revision Date	Prepared By	Checked By
1	Issued for review	12 June 2024	BJ	RB

Electronic file name: Document1

1 IN BRIEF

Alta has been engaged to undertake preliminary budget estimates for three tunnel options and associated work and roading upgrades for Waka Kotahi NZ Transport Agency. The tunnels and associated works are to provide improved connectivity along the State Highway 1 corridor from South of the Mount Victoria Tunnel to North of the existing Terrace Tunnel.

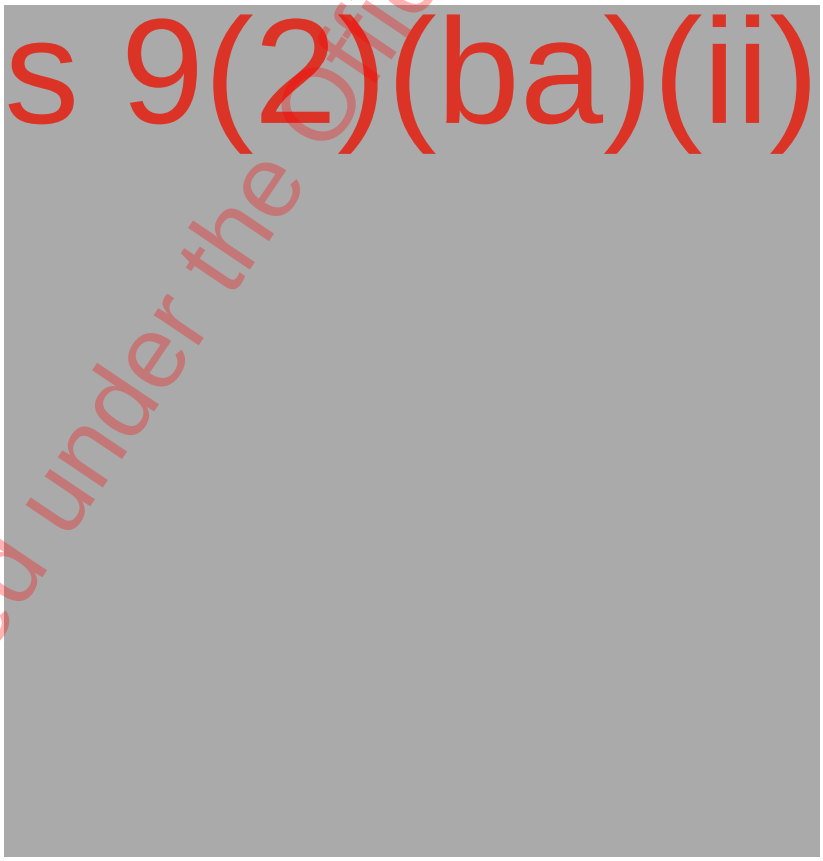
Each option is described further in this report and Table 1 shows the summarised estimated value for each option. Figure 1, 2 & 3 below identifies an overview representation of the proposed options

Options summary	Long Tunnel + Terrace + Adelaide	Long Tunnel + Terrace Tunnel	Diagonal Tunnel + Basin Reserve	Parallel Tunnel + Basin Reserve
Project Base Estimate	$4.0 Bn	$3.73 Bn	s 9(2)(ba)(ii)	
Total Likely Outturn Estimate	$5.24 Bn	$4.87 Bn		
Total Upper Outturn Estimate	$7.65 Bn	$7.10 Bn		

Table 1 - Summary Table of Indicative Business Case Estimates

Figure 1, 2 & 3 below identifies an overview representation of the proposed options for the estimates.

Figure 1 – Long Tunnel Option



2 PROJECT DESCRIPTION

2.1 Scope

Waka Kotahi is undertaking an Indicative Business Case (IBC) study in relation to options for improvements to the State Highway 1 corridor through the Wellington central city. Alta has been engaged to provide indicative business case pricing for four options with options 1 and 2 being a variant of the same base scheme.

The costing information provided in this report is early order of magnitude pricing for the purpose of comparing options. The cost is based on the information provided to date and may vary as further design development takes place. It is recommended that the cost is updated as the design develops for the favourable option.

The four options considered for the IBC study are:

1. Long Tunnel and Terrace Tunnel Duplication Option 1 (excluding Adelaide Road Off-Ramp)
2. Long Tunnel and Terrace Tunnel Duplication Option 2 (including Adelaide Road Off-Ramp)
3. Diagonal Tunnel + Basin upgrades
4. Parallel Tunnel + Basin upgrades

The scope overview of these four options will be briefly further discussed in section 3.

2.2 Information provided

The costs have been developed based on a range of information prepared at different times as the project has been developed. The detail available for estimating varies for each option and where possible the estimates have sought to make like-for-like allowances based on the information.

The information provided is divided into the two sections considering the similarities between options.

2.2.1 Long Tunnel Options

- Long Tunnel – Preliminary Design Memo (May 22nd)
- Geological Long Tunnel long section
- Treatment Appendix
- 5-C4800-00-DES-UTL-MEM-0001

2.2.2 Basin and Mt Vic Options

s 9(2)(ba)(ii)

s 9(2)(ba)(ii)

3 CONSTRUCTION OPTIONS

In the following sections the elements that make up the estimates for each of the options are discussed

3.1 Long Tunnel Option 1 (excluding Adelaide Road Off-Ramp)

This option can be broken down into key components as follows:

- s 9(2)(ba)(ii)
- The Long Tunnel comprises two 12.5m outside diameter twin bored tunnels, each approximately 2.8 kilometres long and accommodating two lanes unidirectional traffic.
- Mined Aotea Fault crossing which includes a shaft.
- Associated approaches and roading upgrades including:
  - s 9(2)(ba)(ii)
  - *Southern Connection* - The Southern Connection involves the construction of a new Kilbirnie Bridge, the reconstruction of the state highway including new on and off-ramps from Kilbirnie, modifications to the local road network, and the construction of additional retaining structures.

3.2 Long Tunnel Option 2 (including Adelaide Road Off-Ramp)

This option can be broken down into several key components as follow:

- s 9(2)(ba)(ii)
- The Long Tunnel comprises of two 12.5m outside diameter twin bored tunnels, each approximately 2.8 kilometres long and accommodating two lanes unidirectional traffic.
- Mined Aotea Fault crossing which includes a shaft.
- Associated approaches and roading upgrades including:
  - s 9(2)(ba)(ii)
  - s 9(2)(ba)(ii)
  - *Southern Connection* - The Southern Connection involves construction of a new Kilbirnie Bridge, the reconstruction of the state highway including new on and off-ramps from

Kilbirnie, modifications to the local road network, and the construction of additional retaining structures.

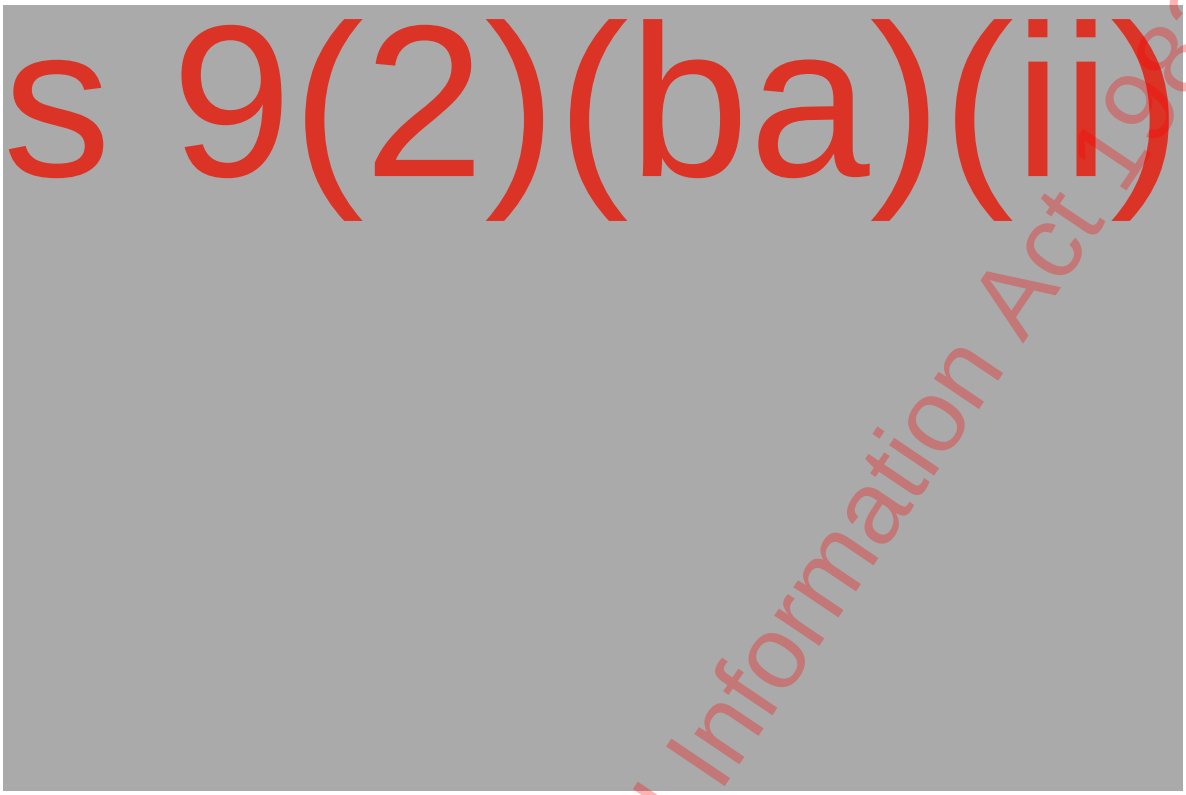
- Mined Adelaide Road off-ramp and cavern including all associated work extending from the southbound tunnel only.

Figure 1 below shows the overview of the Long Tunnel and Terrace Tunnel duplication scope. The difference between the two options is the inclusion or exclusion of the Adelaide Road off-ramp.

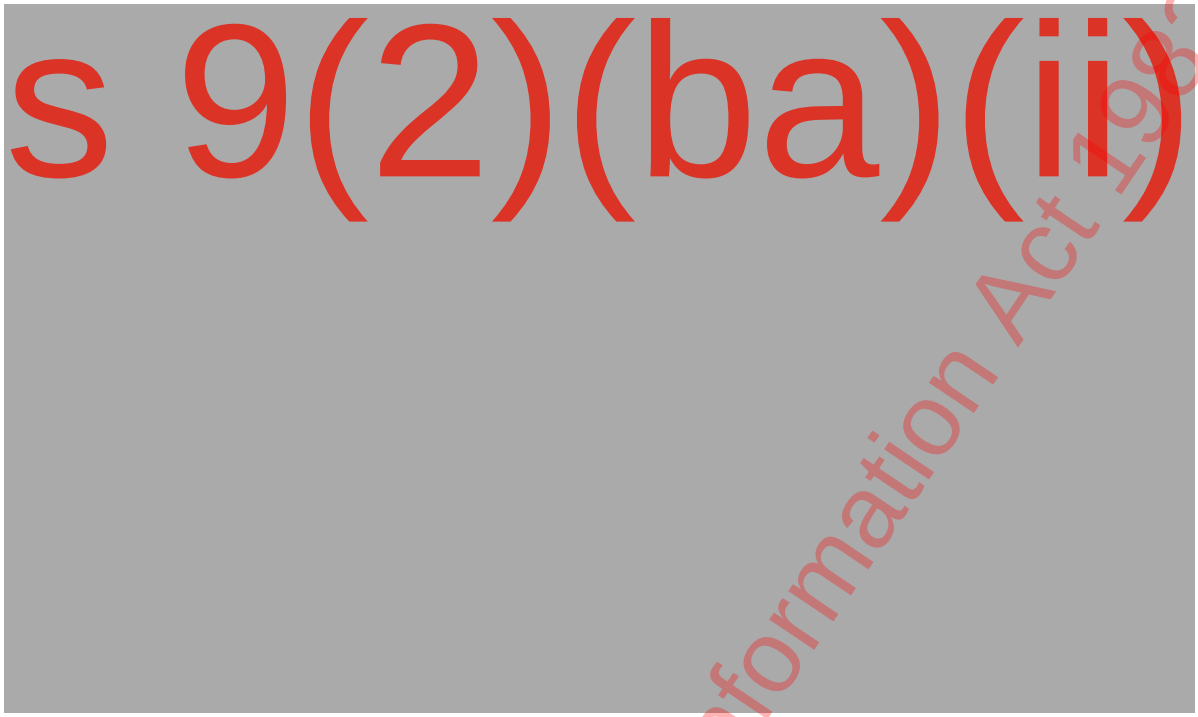
Figure 1 - Long Tunnel Overview.

3.3 Diagonal Tunnel + Basin upgrades

s 9(2)(ba)(ii)



3.4 Parallel Tunnel + Basin upgrades



4 COST ESTIMATE

4.1 Estimate Approach/Method

Alta has used a combination of first principles, unit rate and comparative estimating to arrive at estimates for each of the options. As with all estimates there are constraints that impact the accuracy of the estimate, and this is dependent on estimating assumptions.

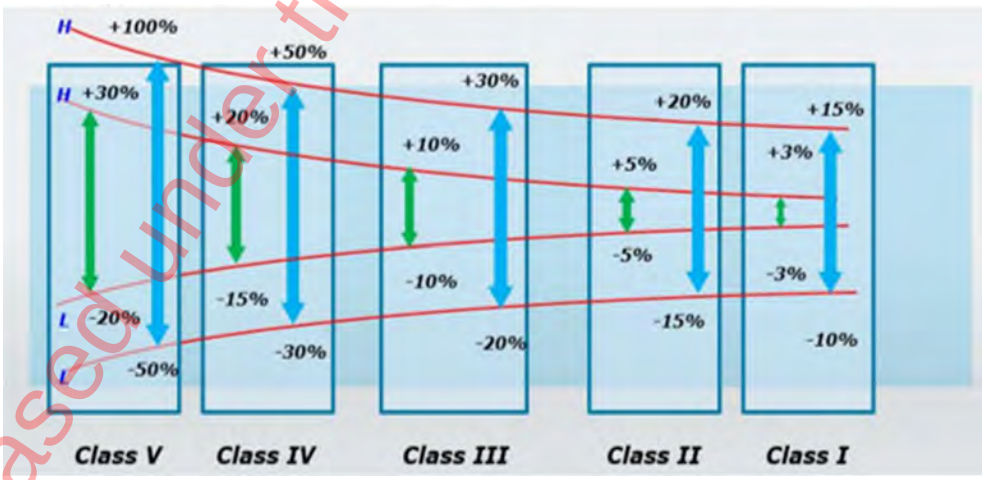
1. The base estimate has been developed using the following method:
   a. The information in the technical notices and drawings has been used to develop rates for defined elements such as the tunnels, structures and roading.
   b. Provision has been made for temporary works, laydown, staging and sequencing as we interpret may be required to support the construction of the permanent works. For example, provision of a tunnelling machine to install the permanent tunnel works shown in the TAN.
   c. Limited assumptions have been made regarding minor elements of permanent works that may not be shown in the project information but are likely to be required.
   d. The estimate is based on a mixture of more detailed bottom-up pricing where there is enough information and top-down or unit rate pricing for items with less information. For example, some of the roading has been estimated based on lane-metre rates, the tunnels have been built up using plant, material and labour rates over an estimated duration.
   e. For identified complex areas of work, unit rates at the higher end of the expected range have been used. This is not considered to be risk, it is simply acknowledging that standard rates may not be applicable due to constraints such as access, working space or timing restrictions.
2. Alta has not priced any risks in the base cost.
3. The base cost has a contingency applied to get to a likely outturn cost, this is to capture the following common items:
   f. Design growth – increased understanding of the scope as the design develops.
   g. Scope creep or the additional of other associated works not currently allowed for or designed.
   h. Risks during construction, such as reductions in productivity due to changes in the ground conditions or increased spoil disposal costs.
4. The contingency allowances vary on different parts of the work depending on the level of confidence in the base information and the estimate for that item.
5. Alta has also considered the level of design development and applied contingency to get to the maximum expected cost (with reference to table 2 and Graphs 1, 2 & 3 below).
   a. To help inform this Alta has used the definitions in the AACE guidelines that discuss the level of project information, the purpose of the estimate and likely estimate accuracy.
      i. For a Class 5 estimate the accuracy could be -50% to +100%.
      ii. For a Class 4 estimate the accuracy could be -30% to +50%.
   b. Alta has estimated contingency between the two at approx. 90%.
6. Alta has evaluated the consequence of some key risks such as productivity losses or spoil cost increases to make sure that these are “containable” inside the most likely contingency and are not “project breaking”.

Table 2 below are the AACE Cost Estimate Classification System which provides guidelines for categorizing project cost estimates based on their level of maturity and quality. It maps the project phases and stages of cost estimating, along with a generic project scope definition matrix. This table was used to guide Alta on the application of contingency percentages based on the estimation classes.

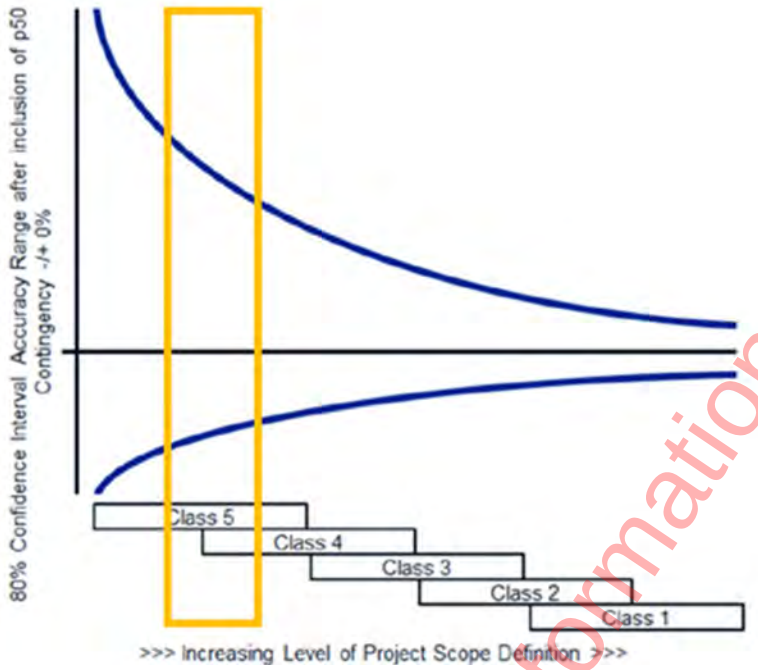
	Primary Characteristic	*Secondary Characteristic*		
ESTIMATE CLASS	**MATURITY LEVEL OF PROJECT DEFINITION DELIVERABLES** Expressed as % of complete definition	**END USAGE** Typical purpose of estimate	**METHODOLOGY** Typical estimating method	**EXPECTED ACCURACY RANGE** Typical variation in low and high ranges at an 80% confidence interval
Class 5	0% to 2%	Concept screening	Cost/length factors, parametric models, judgment, or analogy	L: -20% to -50% H: +30% to +100%
Class 4	1% to 15%	Study or feasibility	Cost/length, factored or parametric models	L: -15% to -30% H: +20% to +50%
Class 3	10% to 40%	Budget authorization or control	Semi-detailed unit costs with assembly level line items	L: -10% to -20% H: +10% to +30%
Class 2	30% to 75%	Control or bid/tender	Detailed unit cost with forced detailed take-off	L: -5% to -15% H: +5% to +20%
Class 1	65% to 100%	Check estimate or bid/tender	Detailed unit cost with detailed take-off	L: -3% to -10% H: +3% to +15%

Table 2 - AACE – Estimate Classification Matrix

Graph 1 and 2 illustrates that as the project definition increases, the accuracy range of estimates narrows towards a more likely sum. If contingency has been addressed appropriately 80% of the projects should fall within the ranges of these graphs.

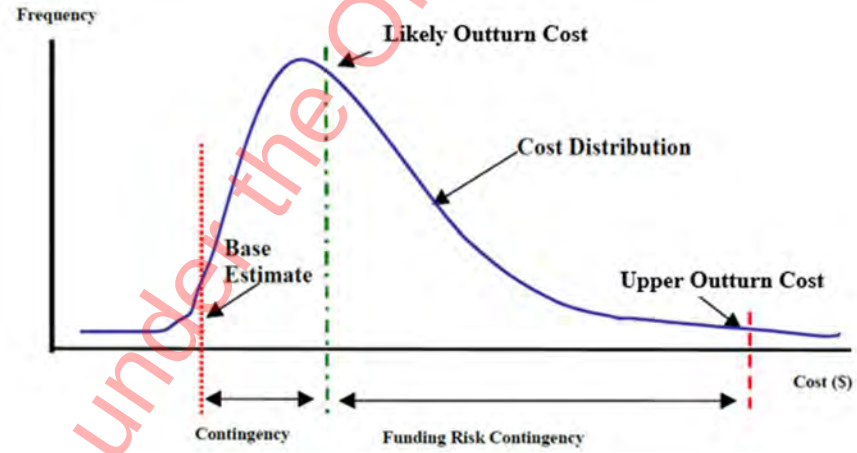


Graph 1 – Estimate Classification positions



Graph 2 - Illustration of the Variability in Accuracy Ranges

Graph 3 below shows a theoretical cost distribution curve based on an Advanced simulation of a project cost estimate, where risk events unfold randomly with varying consequences.



Graph 3 - Illustration of Contingency Curve

These estimates align with the outputs shown in the NZTA cost estimation manual with adjustments made in the summary sheets to accurately represent the project structure and scope. This has been done to facilitate easier comparison between options.

4.2 Assumptions

The assumptions are divided into two parts: the Long Tunnels and the Mount Victoria Tunnels + Basin upgrades.

Each section is further divided into common elements and non-common elements to address areas of similarity between the option estimates.

4.2.1 Long Tunnel Options – Common Elements

4.2.1.1 Tunnel interchange and Connection Costs

As part of the cost estimate, Alta has provided some preliminary costs for the northern and southern tunnel connections including the northern interchange between the Terrace and Long tunnels. The detail provided for these interchanges is limited to concept schematics.

The cost build-up is predominantly based on square meter and cubic metre rates for items such as demolition work, bulk earthworks and soil nail retaining walls respectively.

For bulk earthworks disposal a rate of $15/tonne is used for clean fill and a maximum haulage of 50km from the construction site has been allowed.

10% of the cut volume is assumed to be contaminated and a disposal rate of $50/tonne has been added to the base rate.

Roading has been estimated based on lane metre rates. This is an all-inclusive rate that excludes demolition work, bulk earthworks, retaining structures, viaducts and bridges which are all measured and costed separately. This rate was benchmarked against recent road widening projects of similar nature.

The viaducts and bridge structures have been based of a square metre rate that has also been developed from rates used in recent similar projects.

Lump sum amounts have been allowed tie-ins and lane switch works for each respective area.

The following figures illustrate the various connections and interchanges for this portion of the work.

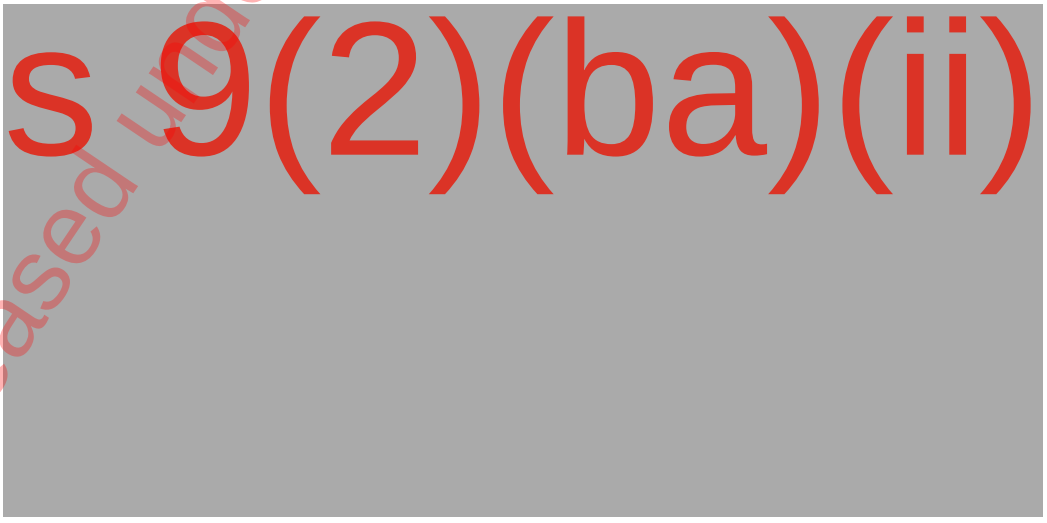


Figure 4 – Northern Connection

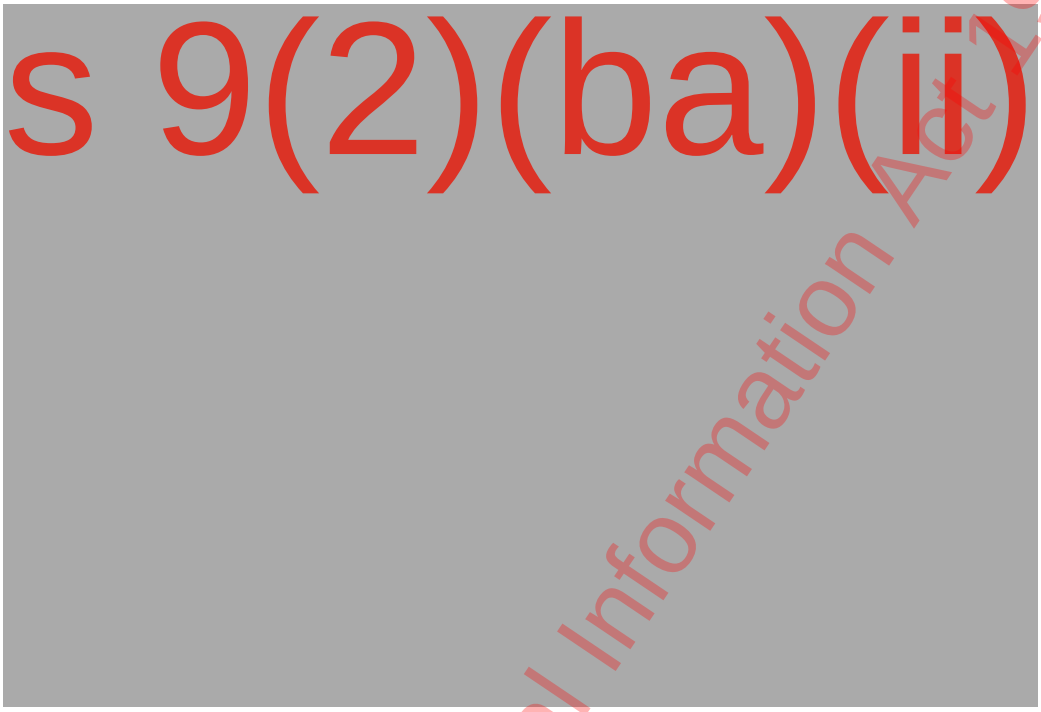


Figure 5 – Northern Interchange

Figure 6 – Southern Connection

4.2.1.2 Terrace Tunnel s 9(2)(ba)(ii)

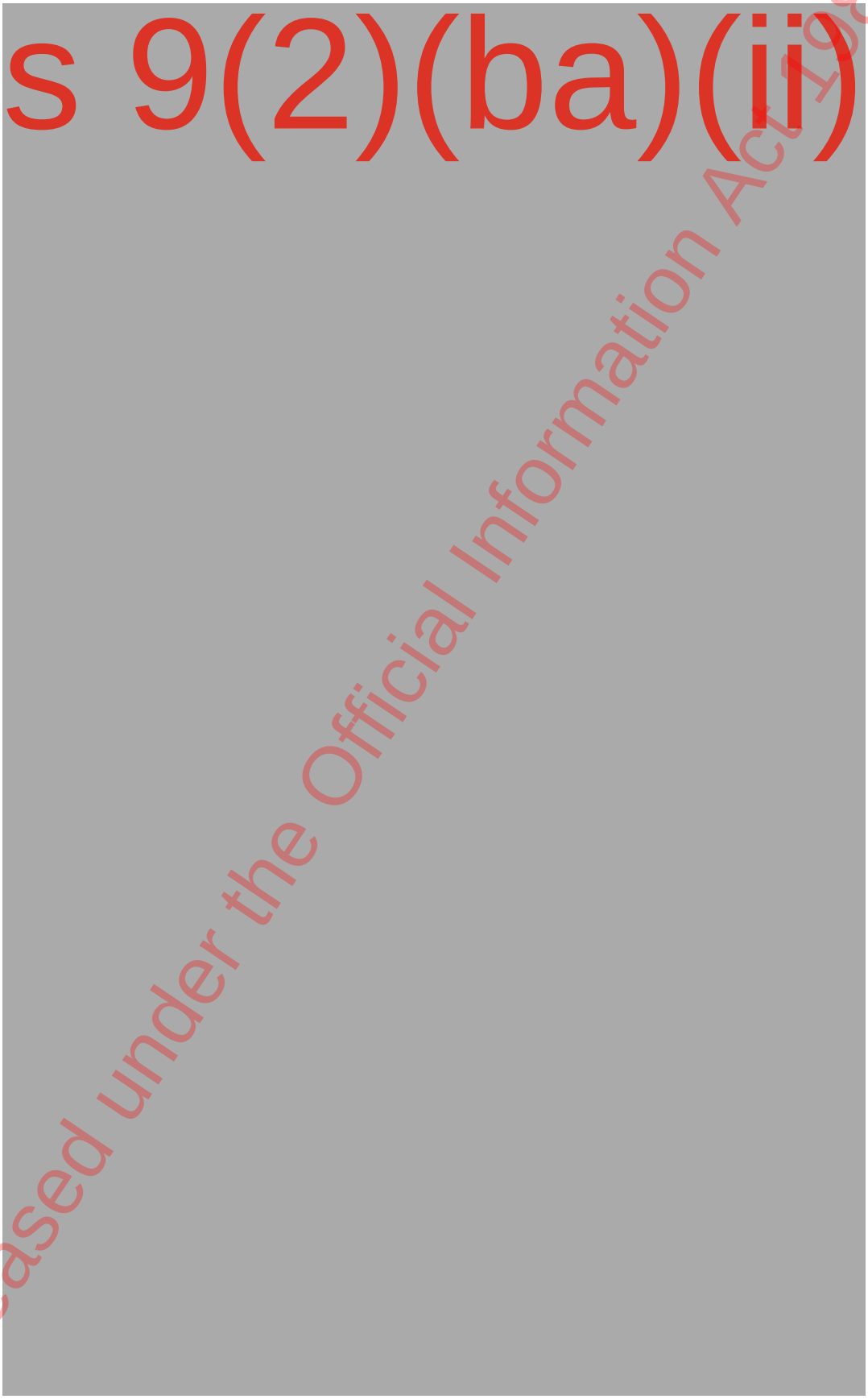


Figure 7 – Terrace Tunnel and Portals

4.2.1.3 TBM Twin Tunnels

The tunnelling construction costs are a build-up of the various plant and crew costs as well as material and tip fee costs. It is assumed that the tunnels will be constructed using two TBMs running concurrently in one direction, with launch and reception portals respectively.

The tunnelling equipment is split between plant purchasing costs, tunnelling consumables and setup and running costs.

The excavation crew cost is worked up from a three-crew roster operating 8-hour shifts. The work faces include the TBM crew and the logistics crew to support excavation and lining.

The crews include for sufficiently skilled and trained tunnel managers as well as shift support operating outside of the tunnelling works.

The excavation material costs we assumed a disposal rate of $15/ton for clean fill and a cartage distance of 50km from the construction site. We further allowed 10% of the cut volumes at the portals to be contaminated and we applied a disposal rate of $50/ton for this material.

Lining crew costs include for reinforcing placement, formwork placement, and concrete placement. The material costs are derived from the tunnel cross sections, and include for reinforcing, concrete, concrete pumping and formwork costs.

No location has been identified for a pre-cast concrete factory and this will need to be further developed in future stages of the project.

Cross passage construction costs and crew costs are based on the length and number of cross passages required at 150m intervals.

The civil crew costs include for the installation of barriers, drainage and water pipes, and other civil elements. The costs for this are determined by the overall construction durations and complexity of the civil fitout.

The mechanical fitout and commissioning costs are developed by applying a 20% factor to the overall tunnel build costs. At this stage of design, there is a high level of uncertainty in the final mechanical and electrical scope.

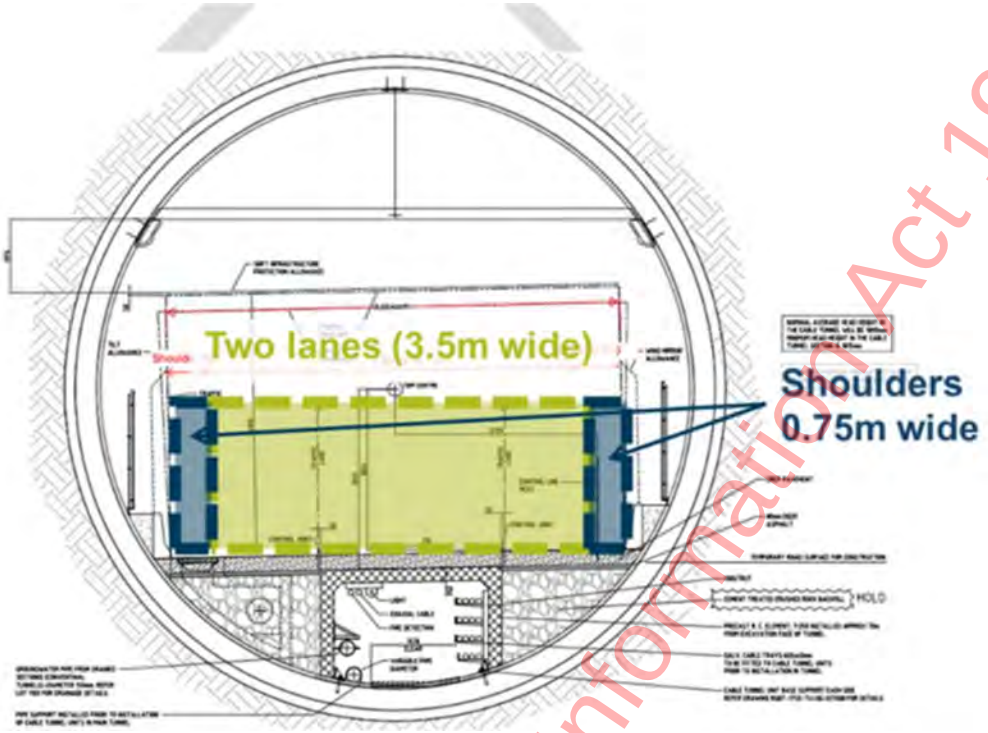


Figure 8 – TBM Tunnel Cross Section

4.2.1.4 Aotea Fault (Mined)

The mined sections within both tunnels follow the same basis as described in item 4.2.1.2 above.

The only addition is that a 20 x 36m piled shaft is allowed for to access the mined cavern sections. All material, plant and labour are accessed to and from the caverns through this shaft.

The above ground site is assumed to be shared with the Adelaide Road Off-ramp site where the off-ramp is included. Where the Adelaide Road Off-ramp is excluded, the same site would only be used for the Aotea Fault works.

Figure 9 illustrates the Aotea Fault Shaft and Caverns for both tunnels.

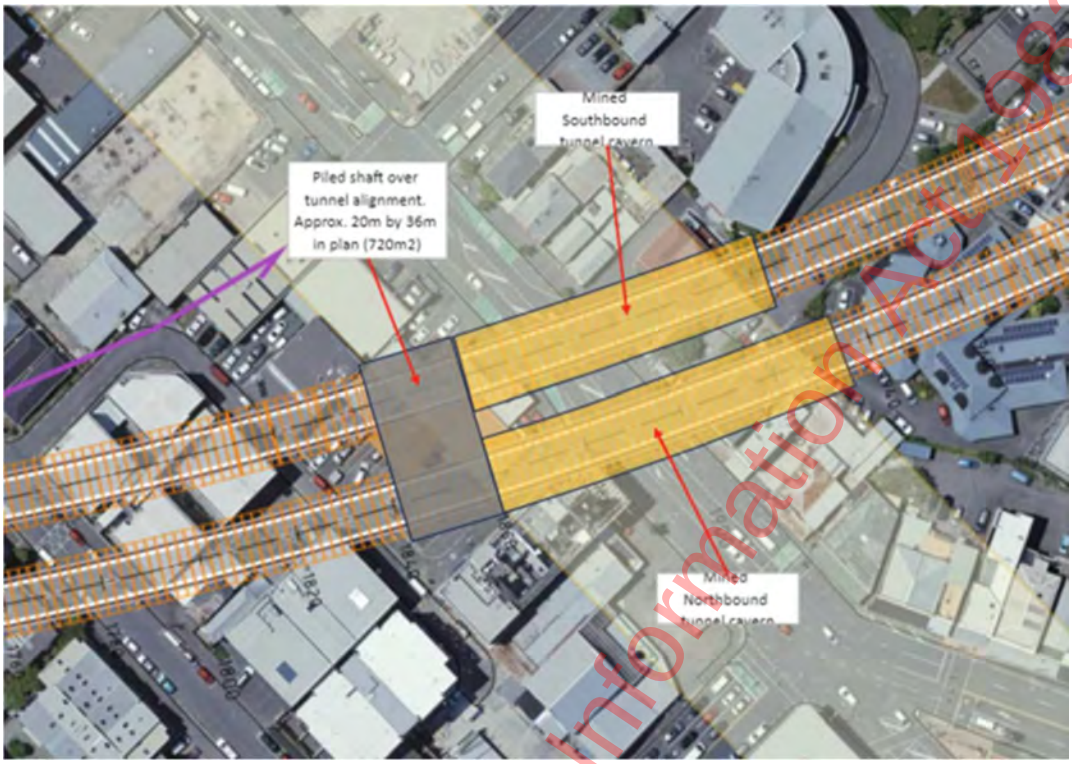


Figure 9 – Aotea Fault Illustration.

4.2.1.5 Relocation of Known U/G Services

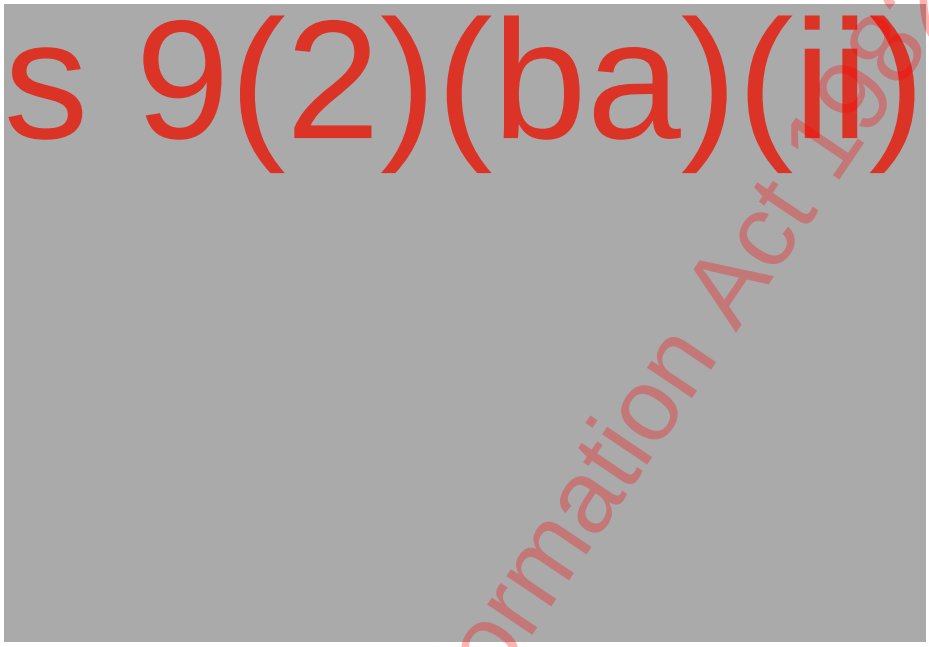
A sum for each identified service as per the memo 5-C4800-00-DES-UTL-MEM-0001 have been allowed for.

4.2.2 Long Tunnel Options – Non-Common Elements

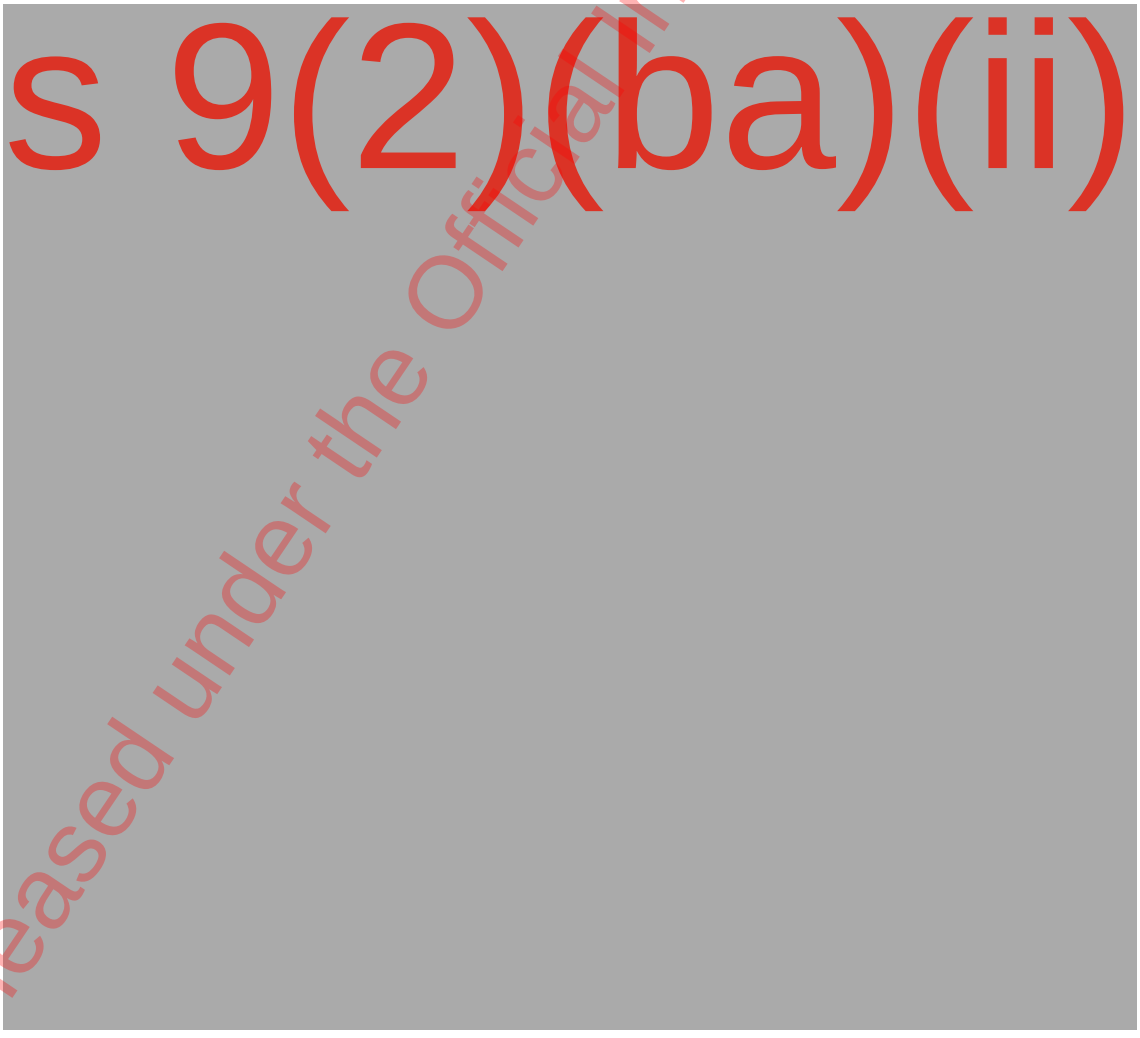
4.2.2.1 Adelaide Road Off-ramp and Cavern

The Adelaide Road Off-ramp and cavern follow the same basis as described in item 4.2.1.2 above.

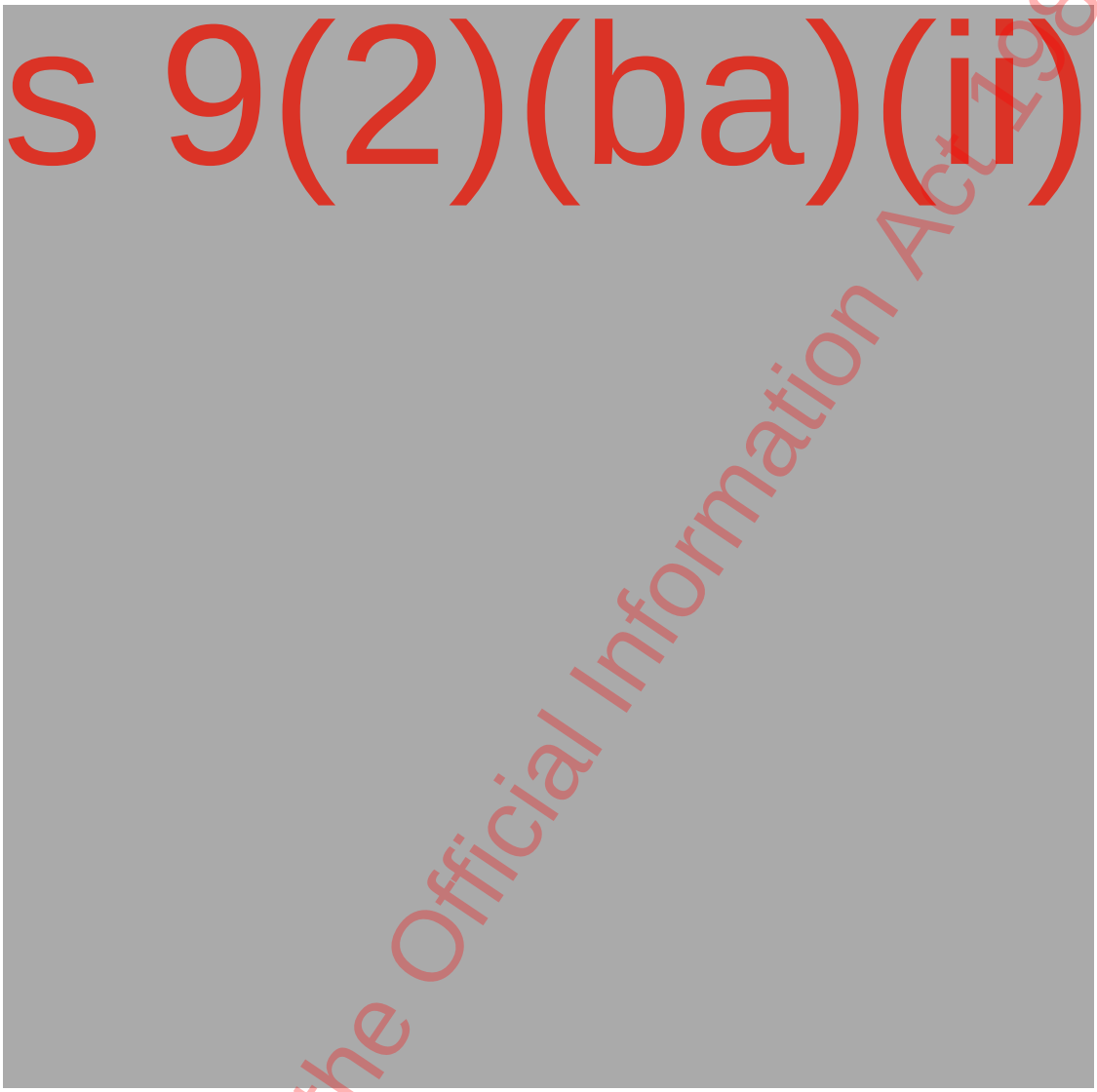
Figure 10 below shows a 3D model of the Adelaide Road Off-ramp and cavern for the Southbound tunnel.



4.2.3.2 Roading Improvements



4.2.3.2 Basin Upgrades



4.2.4 Diagonal and Parallel Tunnel Options + Basin upgrades – Non-Common Elements

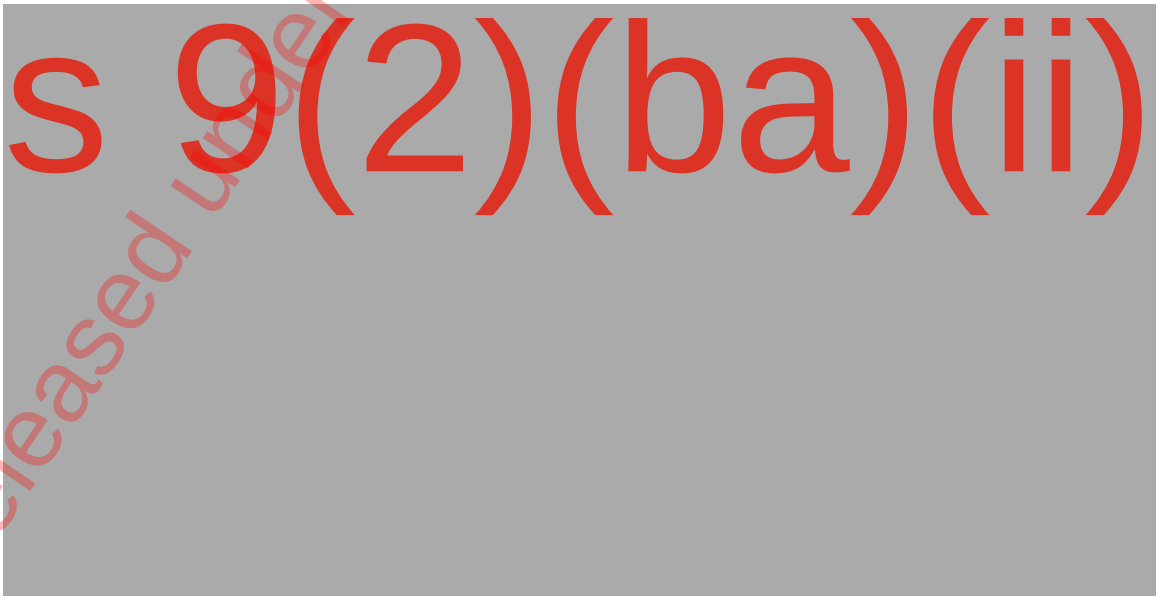
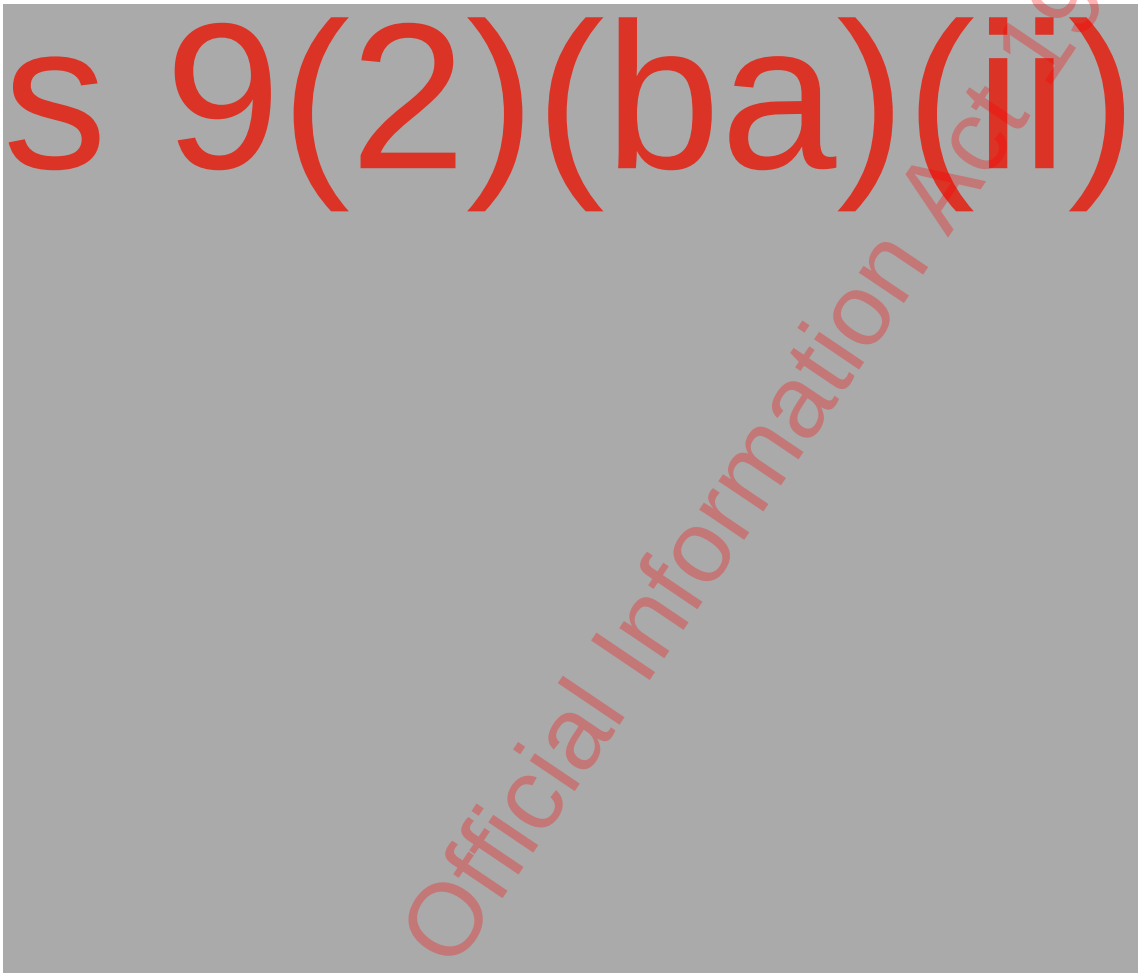
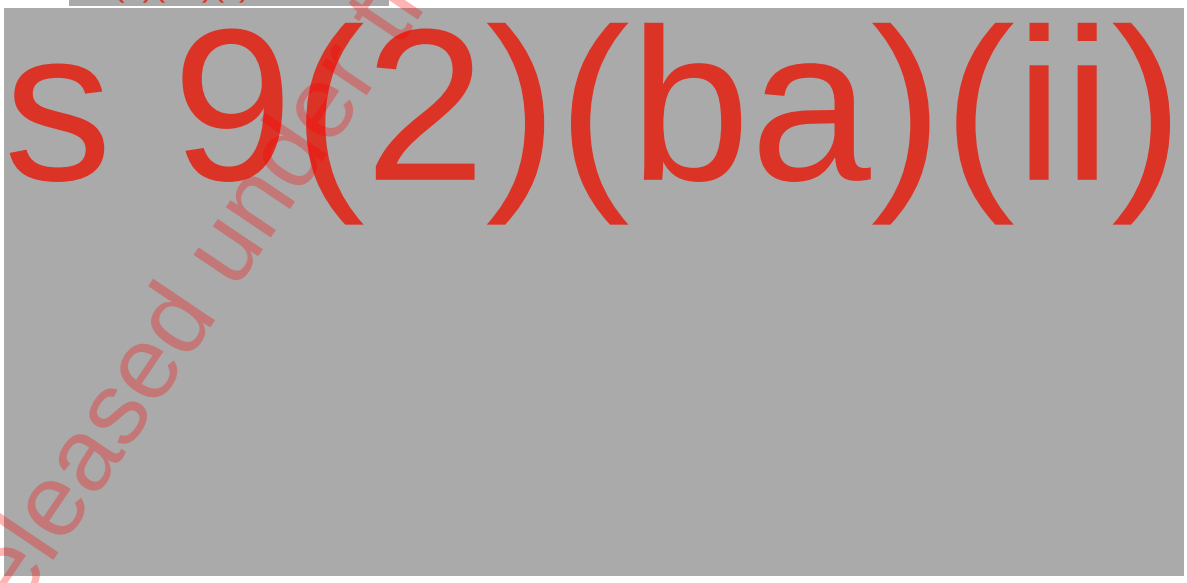


Figure 15 – Ruahine Street and Wellington Road Widening

4.2.4.2 Wellington Road Upgrades (Diagonal Tunnel)



4.3 s 9(2)(ba)(ii)



s 9(2)(ba)(ii)

4.4 Overall Project Cost Allowances

To complete the indicative business case estimates for the various options, percentages for contractor's design, overheads, and margin have been applied to the physical works costs.

Further, percentages have been applied to the construction cost for insurances, site investigations, project development costs, and client internal costs.

Table 3 below indicates the percentages applied for each of these elements. These percentages are determined based on the level of detail and investigation completed to date, ensuring consistency with other similar projects.

Description	Percentage Uplift
Client Internal Costs	
Client Internal Costs	6.50%
Project Development Cost	
Project Development Cost	4.25%
Site Investigations	
Site Investigations	0.50%
Project Specific Insurances	
Project Specific Insurances	0.25%
Construction	
Contractor's Margin	13.00%
Preliminary and General	22.00%
Contractor's Design Elements	6.50%

Table 3 - Overall Project Cost Allowances

5 BENCHMARKING

No benchmarking has been done at this stage although we recommend that an exercise is carried out based on the Waterview Connection outturn costs.

APPENDIX 1 – LONG TUNNEL OPTION 1 (EXCLUDING ADELAIDE ROAD OFF-RAMP AND CAVERN)

WELLINGTON TUNNELS - LONG TUNNEL OPTION 1 (EXCLUDING ADELAIDE ROAD INTERCHANGE)

Project Budget Estimate - Class 5

Item	Description	Base Estimate	Likely Outturn Cost	Upper Outturn Cost
s 9(2)(ba)(ii), s 9(2)(b)(ii)				
8	Project Base Estimate (1+2+3+4+5+6+7) - AACE Class 5	$ 3,728,425,534		
9	Contingency (Assessed/Analysed)	(1+2+3+4+5+6+7)	$ 1,141,292,539	
10	Total Project Expected Estimate	(8+9)	$ 4,869,718,073	
11	Funding Risk - AACE Class 5	(1+2+3+4+5+6+7)		$ 2,228,970,237
12	Upper Outturn Estimate Estimate - AACE Class 5	(10+11)		$ 7,098,688,310
Client Internal Cost Expected Estimate			$ 265,354,671	
Client Design Expected Estimate			$ 173,501,131	
Consent Preparation Expected Estimate - (*Included in Client Internal Cost Expected Estimate)*			$ -	
Site Investigations Expected Estimate			$ 20,411,898	
Property and Utilities Expected Estimate			$ 304,180,000	
Project Specific Insurances Expected Estimate			$ 10,205,949	
Construction Expected Estimate			$ 4,096,064,425	
Date of Estimate		12/06/2024		
Estimate prepared by		Name	s 9(2)(a)	
Estimate internal peer review by		Name		
Estimate external peer review by		Name		
Estimate accepted by		Name		

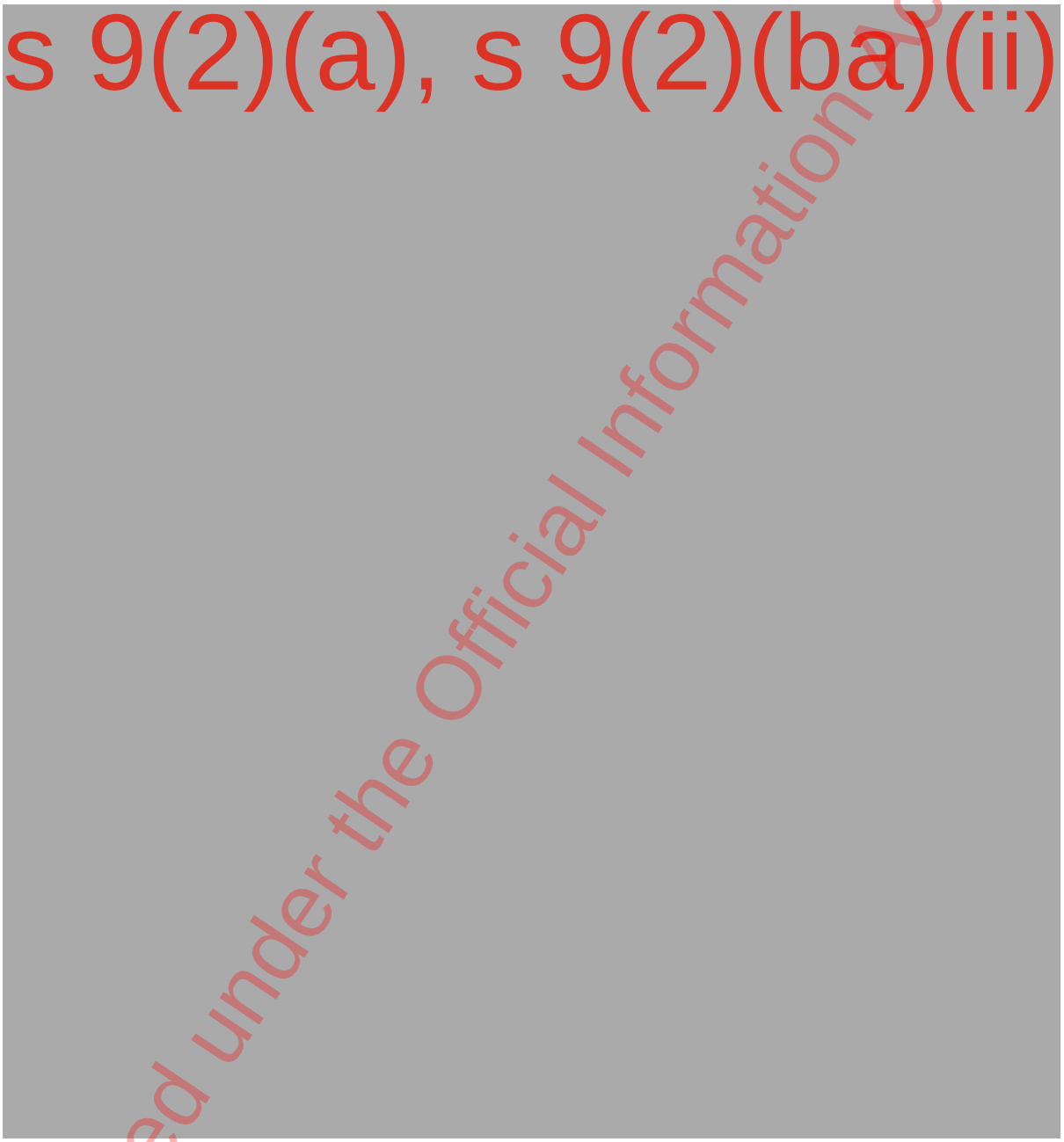
APPENDIX 2 – LONG TUNNEL OPTION 2 (INCLUDING ADELAIDE ROAD OFF-RAMP AND CAVERN)

WELLINGTON TUNNELS - LONG TUNNEL OPTION 2 (INCLUDING ADELAIDE ROAD INTERCHANGE)

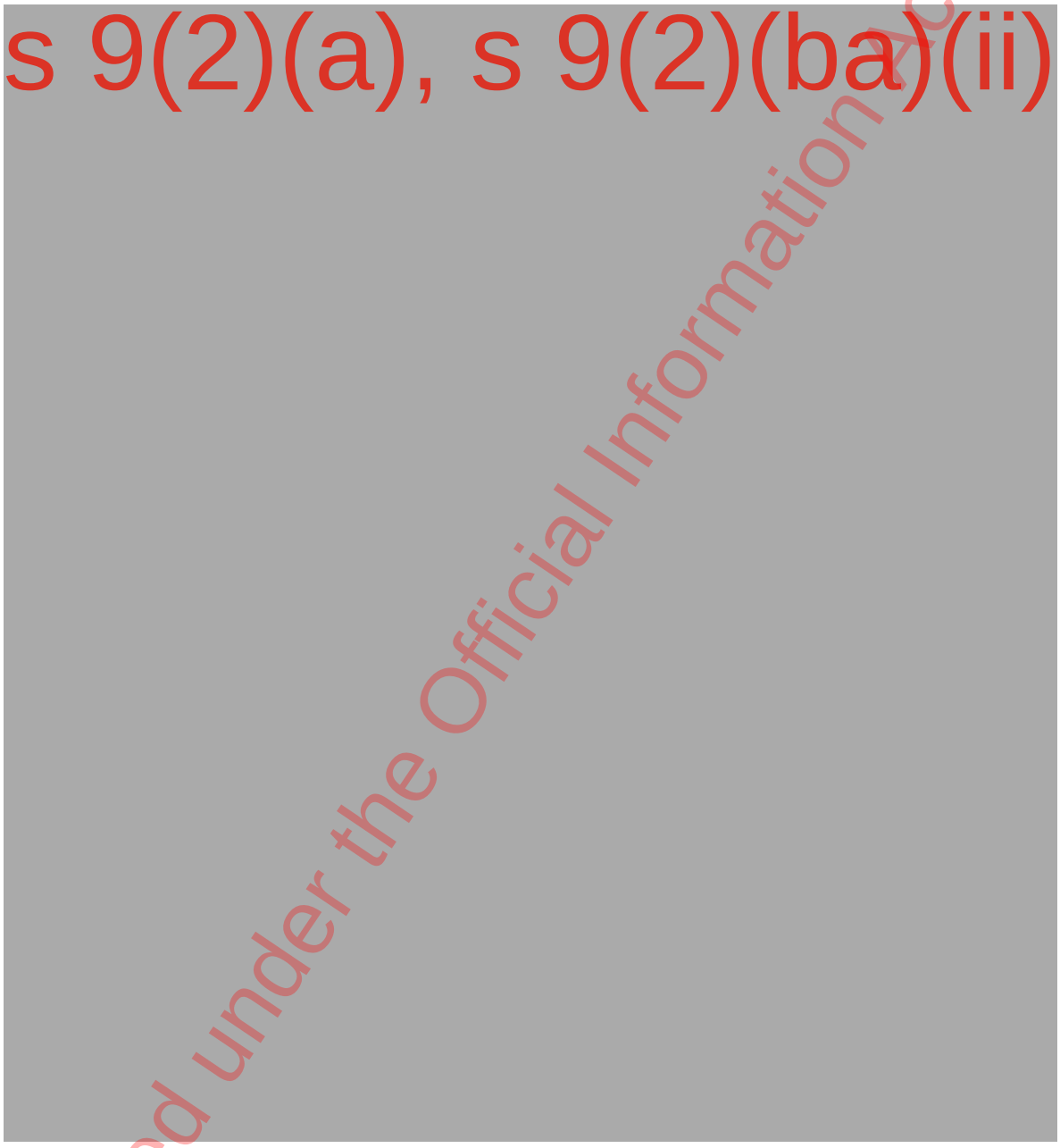
Project Budget Estimate - Class 5

Item	Description	Base Estimate	Likely Outturn Cost	Upper Outturn Cost
s 9(2)(ba)(ii), s 9(2)(b)(ii)				
8	Project Base Estimate (1+2+3+4+5+6+7) - AACE Class 5	$ 4,002,317,138		
9	Contingency (Assessed/Analysed)	(1+2+3+4+5+6+7)	$ 1,238,763,710	
10	Total Project Expected Estimate	(8+9)	$ 5,241,080,847	
11	Funding Risk - AACE Class 5	(1+2+3+4+5+6+7)		$ 2,413,612,924
12	Upper Outturn Estimate Estimate - AACE Class 5	(10+11)		$ 7,654,693,771
Client Internal Cost Expected Estimate			$ 284,368,429	
Client Design Expected Estimate			$ 185,933,203	
Consent Preparation Expected Estimate - ***(Included in Client Internal Cost Expected Estimate)***			$ -	
Site Investigations Expected Estimate			$ 21,874,495	
Property and Utilities Expected Estimate			$ 335,000,000	
Project Specific Insurances Expected Estimate			$ 10,937,247	
Construction Expected Estimate			$ 4,402,967,473	
Date of Estimate		12/06/2024		
Estimate prepared by		Name	s 9(2)(a)	
Estimate internal peer review by		Name		
Estimate external peer review by		Name		
Estimate accepted by		Name		

APPENDIX 3 – DIAGONAL TUNNEL AND BASIN UPGRADES



APPENDIX 4 – PARALLEL TUNNEL AND BASIN UPGRADES



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