Bridge Concept and High-Level Cost Estimate

Wonthaggi North East PSP

22800-01

Prepared for
Victorian Planning Authority (VPA)

13 September 2022

Cardno

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Document Information

Prepared for	Victorian Planning Authority (VPA)
Project Name	Wonthaggi North East PSP
File Reference	22800-01 Concept Report (04).docx
Job Reference	22800-01
Date	13 September 2022
Version Number	04

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Effective Date 19/11/2021

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Date Approved 22/11/2021

Document History

Version	Effective Date	Description of Revision	Prepared by	Reviewed by
01	19/11/2021	Draft to VPA	Shadia C	Shadia C
02	22/11/2021	Final to VPA	Shadia C	James L
03	11/07/2022	Revised Costings	James L	James L
04	13/09/2022	Revised Costings	Shadia C	Shadia C

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1 Introduction

As part of the Wonthaggi North East Precinct Structure Plan (PSP), Cardno were engaged to complete a concept design and high-level costing for three (3) crossings spanning East-West across the main outfall channels. The crossings are required for the land owner at 465 Heslop Road, Wonthaggi to be able to access the other paddocks part of their property once the channels are upgraded as part of the stormwater management upgrade plan.

The paddocks are part of a floodplain therefore during large events (i.e. 1% AEP and larger) this area is expected to flood, especially towards the East of the proposed channel upgrades. Whereas the small/frequent events (i.e.: 1 in 50year events) where overflows from Powlett River occur will be contained within the proposed channel upgrades therefore having less impact on the surrounding paddocks.

This formed part of the selection criteria for the 50% AEP clearance height for all of the crossings in conjunction with the vertical clearance requirements outlined for minor bridges in AS5100.1.

Cardno have used the Alluvium Hecras model and CAD set provided on the 9th of November to determine the crossing width and associated flood levels for Crossing CU14 and Crossing CU16. The cross-sectional dimensions of Crossing CU15 over the channel is based on the survey file provided by Victorian Planning Authority (VPA) on 26th of October.

This report and drawing set will form part of the Development Contributors Plan (DCP) as it identifies the contributing assets which require funding to implement the PSPs.

2 Infrastructure Elements

2.1 Crossing CU15

The channel where crossing CU15 is located has a top width of approximately 3,600mm and a depth at the midpoint of 735mm. As outlined above, the channel is designed to contain the 50% AEP which at this location in the channel is outlined as RL 13.74m, 150mm from the top of the channel.

To ensure the structure is not within the channel and is clear of the banks the overall bridge length is approximately 3,800mm with the soffit of the structure set 200mm above the 50% AEP level.

As outlined in the brief for this project the land owner requires the bridge structure to achieve a minimum width of 3000mm and accommodate livestock and farm machinery. Therefore, the bridge has been designed to carry a transient load of 10T.

Taking these requirements into account a precast structure has been selected as the best suited construction methodology due to the span, loading and ease of construction. Three (3) 220mm Thick Hollow Core Concrete (HCC) Planks will be connected to proprietary bearings fixed to cast-insitu concrete abutments at each end with bored piles if required. The requirement for piles is dependant on the geotechnical founding material which will be need to be determined if the design progresses.

A concrete screed over the planks will be installed to connect the planks and provide a wearing course for the transient load.

Approach slabs graded from the bridge to match into Natural Surface Level (NSL) at 15.8% in accordance with Austroads requirements will sit upon beaching/basalt with three (3) concrete pipes laid within the material. The concrete pipes will decrease from 250mm to 150mm as the approach slopes downward toward the NSL. These pipes will allow the larger flood events to pass below the structure, reducing the impact of

the additional surface area within the flood plain. The approach has been graded at a slightly steeper grade to reduce the impact of the structure on the land owner's property.

The overall width of the new structure will be 3,590mm, with a clear width between barriers of 3,090mm which is the closet to 3000mm that can be achieved using proprietary products meeting the brief items. Note this width does not meet AS51000.1 clause 13.4 geometric requirements for a single lane road bridge. Although the code notes that it is acceptable to utilise a different width if approved by the relevant authority. Cardno believe due to the use of the structure not being for public access the width provided will be suitable.

A galvanised steel, post and rail system will be fixed to the edge of the deck on each side of the bridge complying with AS5100.1 clause 14.6.2 geometric requirements. Due to the height over the waterway, access specifications and depth of water below the structure barriers will be required with an effective containment level of 'low performance'. The barriers have a min. effective height of 600mm and an overall height of min. 700mm.

2.2 Crossing CU14

The channel where crossing CU14 is located has a top width of approximately 8,160mm and a depth at the midpoint of 1,220mm. As outlined above, the channel is designed to contain the 50% AEP which at this location in the channel is outlined as RL 13.80m, 810mm from the top of the channel.

To ensure the structure is not within the channel and is clear of the banks the overall bridge length is approximately 8,890mm with the soffit of the structure set 900mm above the 50% AEP level.

As outlined in the brief for this project the land owner requires the bridge structure to achieve a minimum width of 3000mm and accommodate livestock and farm machinery. Therefore, the bridge has been designed to carry a transient load of 10T.

Taking these requirements into account a precast structure has been selected as the best suited construction methodology due to the span, loading and ease of construction. Four (4) 400mm Thick Hollow Core Concrete (HCC) Planks will be connected to proprietary bearings fixed to cast-insitu concrete abutments at each end with bored piles if required. The requirement for piles is dependent on the geotechnical founding material which will be need to be determined if the design progresses.

A concrete screed over the planks will be installed to connect the planks and provide a wearing course for the transient load.

Approach slabs graded from the bridge to match into Natural Surface Level (NSL) at 10% in accordance with Austroads requirements will sit upon beaching/basalt with three (3) concrete pipes laid within the material. The concrete pipes will decrease from 300mm to 150mm as the approach slopes downward toward the NSL. These pipes will allow the larger flood events to pass below the structure, reducing the impact of the additional surface area within the flood plain. The approach has been graded at a slightly steeper grade to reduce the impact of the structure on the land owner's property.

The overall width of the new structure will be 4,800mm, with a clear width between barriers of 4,500mm which is achieved using proprietary products meeting the brief items. Note this width complies with AS51000.1 clause 13.4 geometric requirements for a single lane road bridge. Cardno believe due to the use of the structure not being for public access the width provided will be suitable.

A galvanised steel, post and rail system will be fixed to the edge of the deck on each side of the bridge complying with AS5100.1 clause 14.6.2 geometric requirements. Due to the height over the waterway, access specifications and depth of water below the structure barriers will be required with an effective containment level of 'low performance'. The barriers have a min. effective height of 600mm and an overall height of min. 700mm.

2.3 Crossing CU16

The channel where Crossing CU16 is located has a top width of approximately 18,100mm and a depth at the midpoint of 1,240mm. As outlined above, the channel is designed to contain the 50% AEP which at this location in the channel is outlined as RL 13.40m, 135mm from the top of the channel. Within the channel there are 5x1500 diameter existing pipes which were modelled as part of the Alluvium package of work for 50% blockages.

To ensure the structure is not within the channel, clear of the existing pipes and is clear of the banks the overall bridge length is approximately 18,800mm with the soffit of the structure set 430mm above the 50% AEP level. The existing pipes are designed to remain within the channel therefore a clear span structure will not apply any load to these pipes and ensure the current integrity is maintained.

As outlined in the brief for this project the land owner requires the bridge structure to achieve a minimum width of 3500mm and accommodate livestock, farm machinery and a 3-axle truck. Therefore, the bridge has been designed to carry a transient load of 22.5T.

Taking these requirements into account a precast structure has been selected as the best suited construction methodology due to the span, loading and ease of construction. Two (2) 750mm deep precast open top super t planks will be connected to proprietary bearings fixed to cast-insitu concrete abutments at each end with bored piles if required. The requirement for piles is dependent on the geotechnical founding material which will be need to be determined if the design progresses.

A concrete deck and screed over the planks will be installed to connect the planks and provide a wearing course for the transient load.

Approach slabs graded from the bridge to match into Natural Surface Level (NSL) at 12.3% in accordance with Austroads requirements will sit upon beaching/basalt with three (3) concrete pipes laid within the material. The concrete pipes will decrease from 800mm to 400mm as the approach slopes downward toward the NSL. These pipes will allow the larger flood events to pass below the structure, reducing the impact of the additional surface area within the flood plain. The approach has been graded at a slightly steeper grade to reduce the impact of the structure on the land owner's property.

The overall width of the new structure will be 4,700mm, with a clear width between barriers of 4,200mm which is achieved using proprietary products meeting the brief items. Note this width complies with AS51000.1 clause 13.4 geometric requirements for a single lane road bridge. Cardno believe due to the use of the structure not being for public access the width provided will be suitable.

A galvanised steel, post and rail system will be fixed to the edge of the deck on each side of the bridge complying with AS5100.1 clause 14.6.2 geometric requirements. Due to the height over the waterway, access specifications and depth of water below the structure barriers will be required with an effective containment level of 'low performance'. The barriers have a min. effective height of 600mm and an overall height of min. 700mm.

3 Cost Estimate

This section of the report outlines how the cost was derived, the cost estimate itself and the viability of the data based on the methodology of the sourced cost.

3.1 Methodology

The methodology used to derive a high-level cost estimate for the structures outlined in section 1 of this report is a conjunction of estimations based on rates from the Rawlinson's Construction Handbook in conjunction with a rate we have established based on construction costs of small bridge structures from previous projects.

To effectively use the Rawlinson's Construction Handbook a breakdown was created of each of the elements required which form the bridge structure and their associated volume, area or number of items which will be required. The additional construction requirements i.e.: machinery, excavation etc and other ancillary items were also estimated for each of the bridge structures. The rate as per the 2021 handbook was calculated against these items to form a high-level construction cost estimate for each structure.

The internal construction rate for minor bridge structures is calculated using $/m^2 therefore utilises the following inputs to create an estimated construction price:

1. Traffic Lane/s
    - Required width
    - Number of Lanes
2. Footpath
    - Required Width
    - Number of Footpaths
3. Shared Use Path (SUP)
    - Required Width
    - Number of SUPs
4. Barrier
    - Required Width
    - Number on Structure

For this structure only, item 1 and 4 are applicable and were utilised in the cost estimate calculation.

3.2 Assumptions

In order to provide the estimate at this stage of the planning phase a number of assumptions were required to be made. These assumptions are outlined below:

- The proposed channels will have been constructed prior to the commencement of the bridge construction. No allowance has been made for this in the estimation.
- It is assumed that the founding conditions will be sufficient for the design loads induced by this structure.
- No allowance has been made for any demolition work on this site as the site is assumed to be greenfield.
- It is assumed there are no utilities near the structure. No allowance has been made as part of the design for proximity of utilities to the bridge or for utility relocation works.

- No allowance has been made for lighting of the bridges and associated requirements to enable this.
- Analysis of the vehicle turn allowance onto the bridge structures has not been calculated although proximity of boundaries has been considered.
- The rate utilised is for simple bridge construction of small planks or super Ts;
- No allowance has been made for alterations to the existing pipes already contained within the channels;
- Scour to the channel embankments has not be considered in this scope of work;

3.3 Results of Estimation

The outcome of the cost estimation utilising the information outlined in section 2 and section 3 of this report is presented in table 1 below. The estimate represents the cost of the breakdown of elements utilising the Rawlinson's Construction Handbook 2021 edition and the outcome utilising the rate established based on previous construction costs. Refer Appendix A for concept drawings of each of these structures and Appendix B for the cost estimate break down.

Item	Category	Description	Cost per Application	Estimate
1	Bridge	3.8m HCC Bridge	Per bridge	$ 117,738.54
2	Bridge	8.8m HCC Bridge	Per bridge	$ 249,870.77
3	Bridge	18.8m Super T Bridge	Per bridge	$ 635,412.99

Table 1 – Cost Estimate

Note:

1. All estimates include an additional 35% buffer for contingency;

2. The costs are high level only and that during the completion of a competitive tender or QS be engaged; more accurate pricing will be provided;

3. If all three (3) bridges are constructed by one (1) contractor additional cost benefits may be available;

3.4 Breakdown of Results

Overall the price of each structure has a slight variance in price depending on the estimation method used. However, the price variance isn't significant.

The square meter rate resulted in a slightly cheaper rate for the main bridge itself although due to the non-standard approaches to the bridges, this was not able to be incorporated into the figure appropriately.

The breakdown of results provides a better estimation as each of the non-standard elements are able to be itemised as shown in appendix B.

4 Conclusion

The concept design and construction cost estimation assessment of the three (3) identified crossings over the proposed channels as part of the Wonthaggi North East Precinct Structure Plan (PSP) was able to identify the main requirements to be achieved and best fit structures for the purpose of providing a high-level cost estimate to enable funding to be sourced to complete this work package.

Once funding has been sourced further investigations will be required including survey of the as constructed channels and geotechnical investigations, as well as detailed design of the crossings.

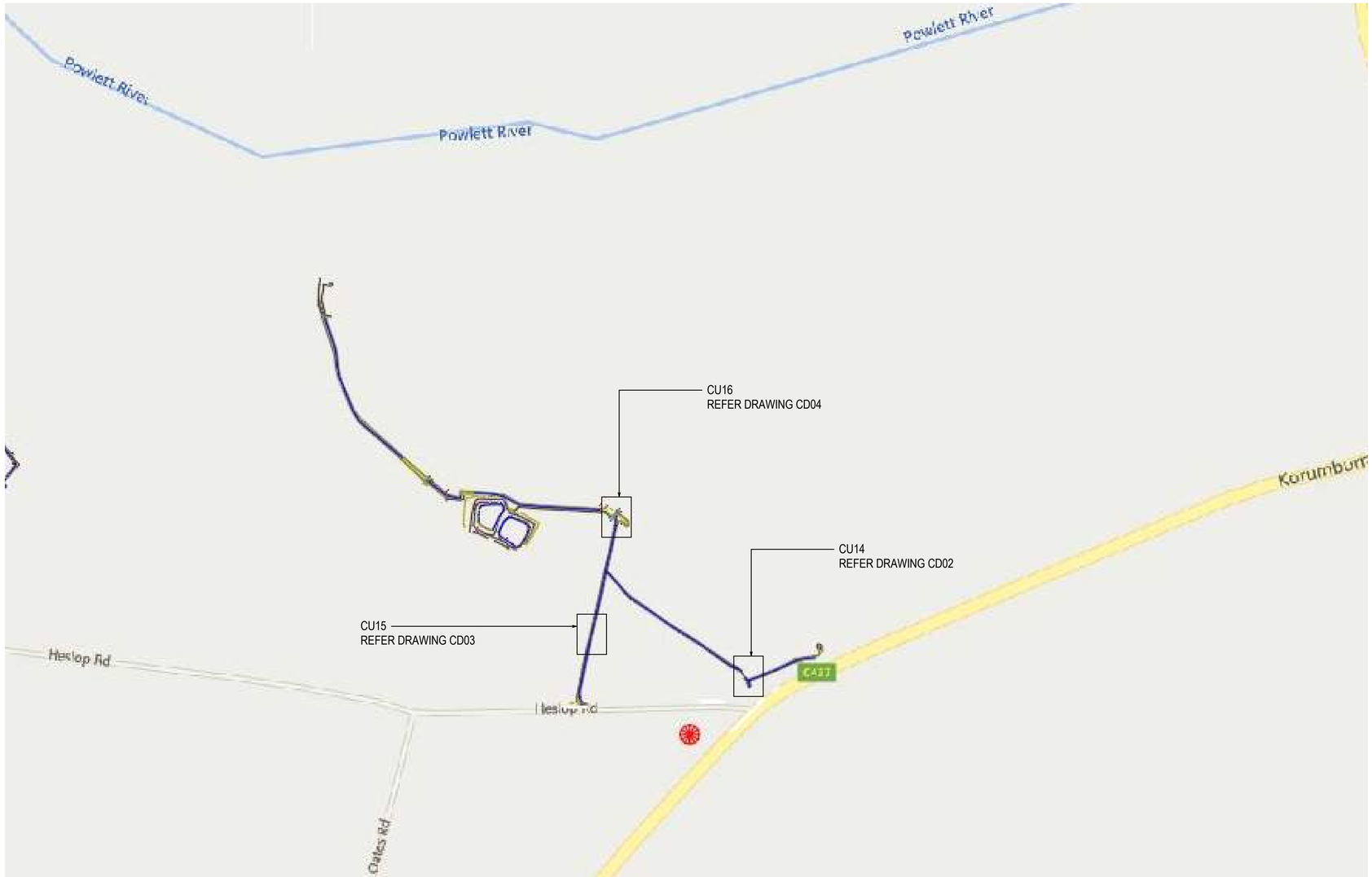
Appendix A – Concept Drawings

WONTHAGGI NORTH PSP - BRIDGE CONCEPTS

FOR
VICTORIAN PLANNING AUTHORITY

DRAWING INDEX

CD01	GENERAL NOTES & SCHEDULE OF DRAWINGS
CD02	CU14 - GENERAL ARRANGEMENT PLAN
CD03	CU15 - GENERAL ARRANGEMENT PLAN
CD04	CU16 - GENERAL ARRANGEMENT PLAN



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ISSUE	ISSUED FOR / AMENDMENT:	DATE:	DRAWN:	APPROVED:
01	DRAFT CONCEPT ISSUE	19.11.2021	PMD	SC
02	CONCEPT ISSUE	22.11.2021	PMD	SC

DESIGNED:	SC	DATE:	NOVEMBER 2021
DRAWN:	PMD	SCALE:	AS SHOWN
SURVEY:		SHEET SIZE:	A1
CHECKED:	JL	APPROVED:	JL
DATE:	22.11.2021	DATE:	22.11.2021

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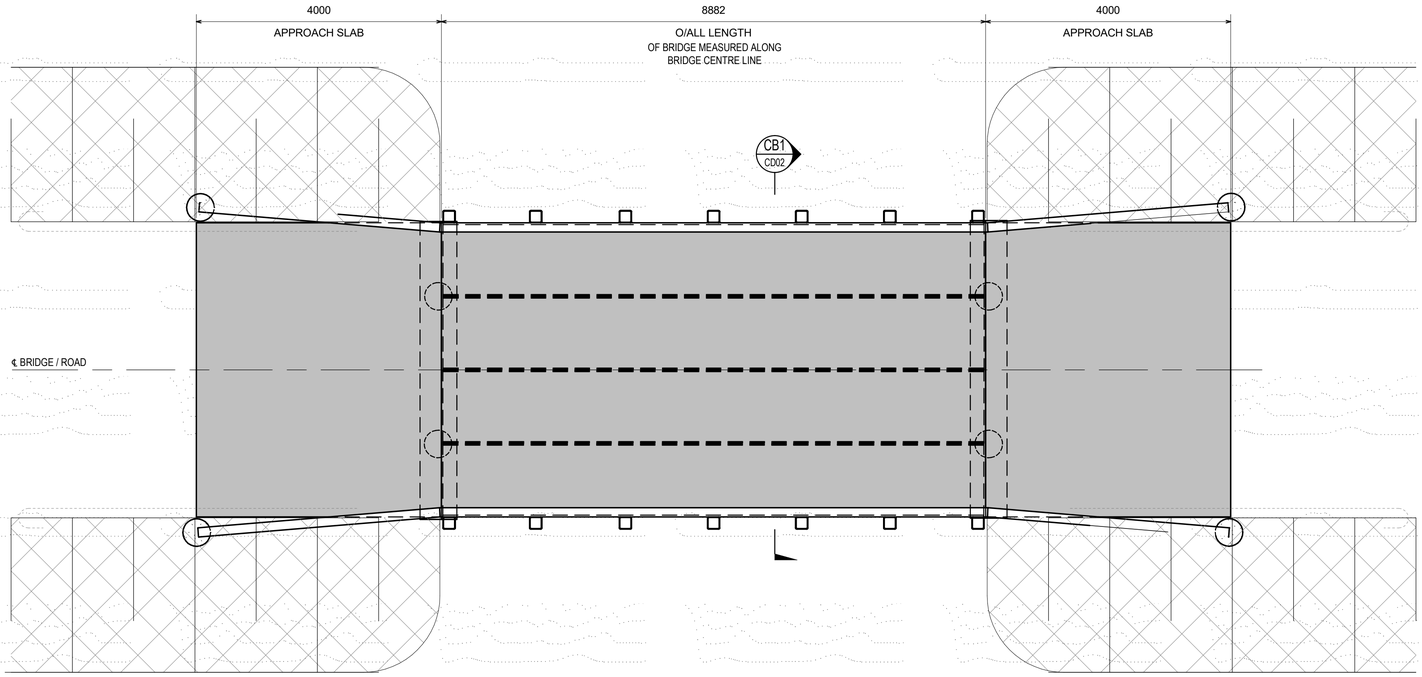
PROJECT: WONTHAGGI NORTH EAST PSP
BRIDGE CONCEPTS

STRUCTURAL DRAWINGS

DRAWING TITLE: GENERAL NOTES & SCHEDULE OF DRAWINGS

TGM REF. No.: 22800-01 | SHEET: CD01 | ISSUE: 02



CU14 - GENERAL ARRANGEMENT - PLAN

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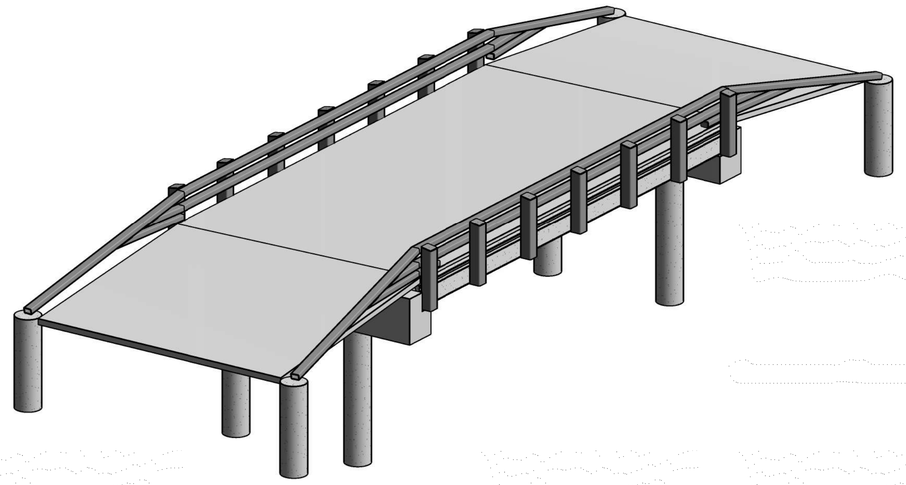

CU14 - 3D VIEW

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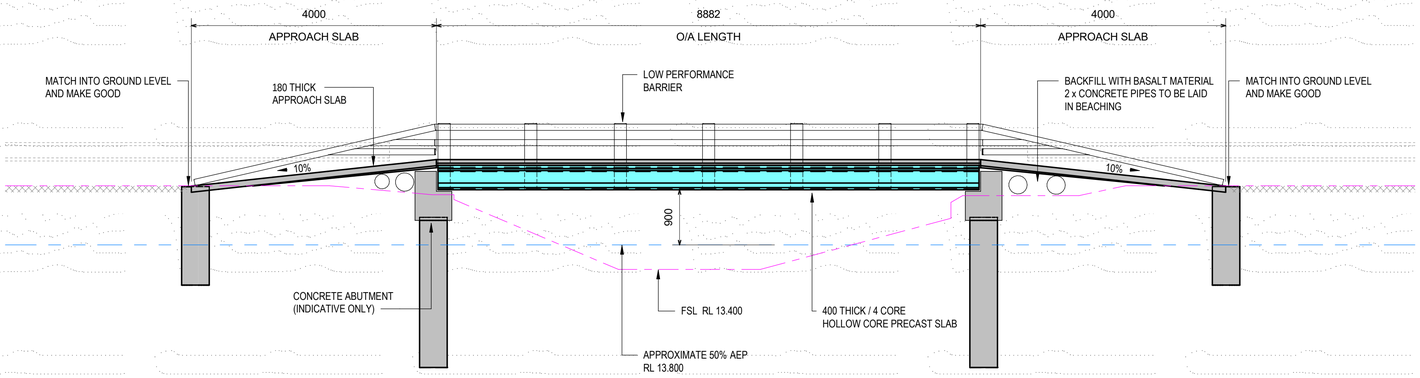

CU14 - ELEVATION

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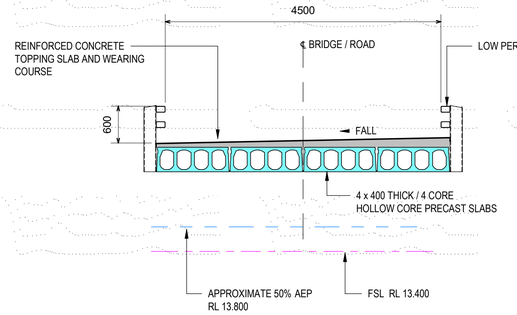

SECTION CB1 / CD02

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NOTE:

1. CAPACITY LIMIT FOR THIS BRIDGE IS 10T
2. REFER VPA PLAN 7 INTERGRATED WATER MANAGEMENT PLAN FOR EXACT LOCATION

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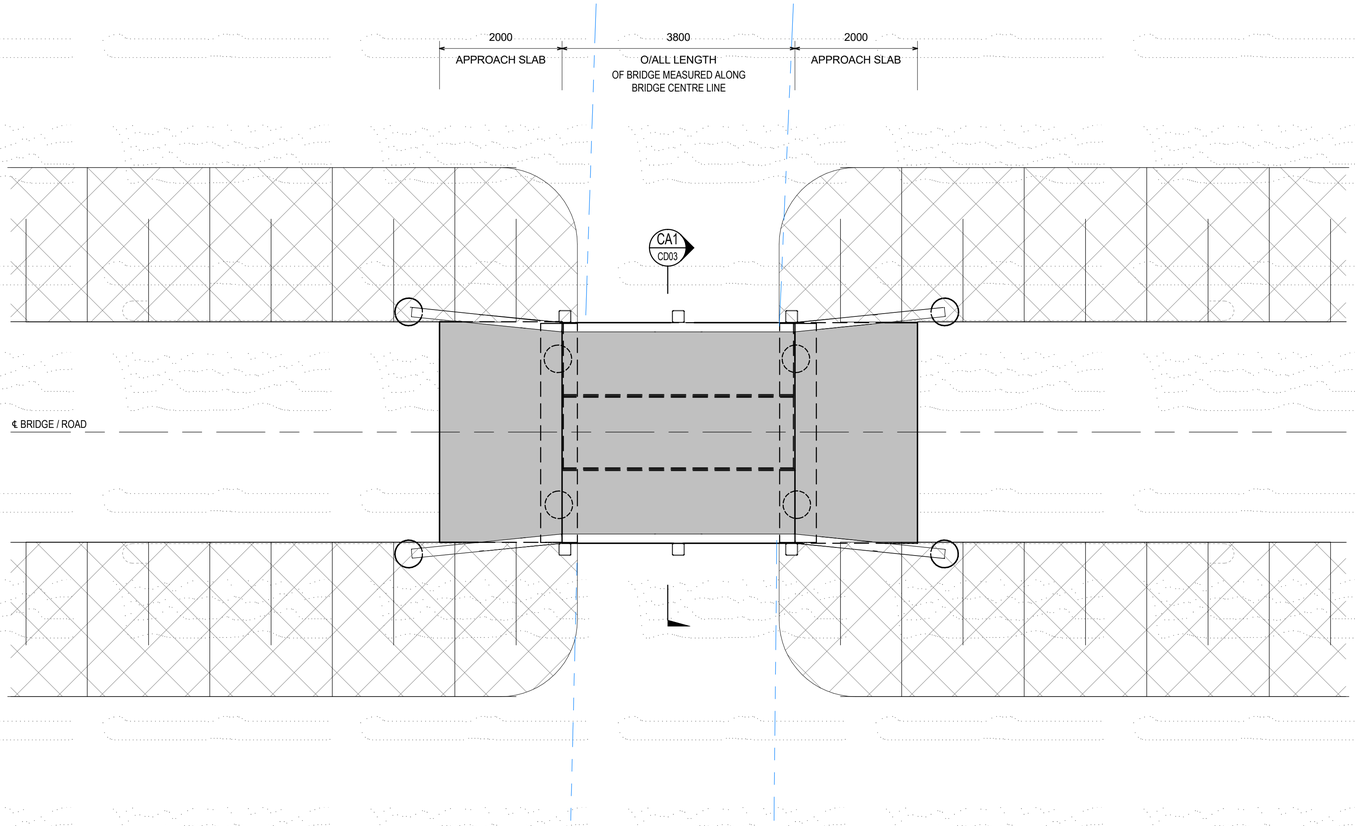
BRIDGE CONCEPTS

STRUCTURAL DRAWINGS

NORTH

DRAWING TITLE: CU14 - GENERAL ARRANGEMENT PLAN

TGM REF. No.:	SHEET:	ISSU
22800-01	CD02	02



CU15 - GENERAL ARRANGEMENT - PLAN

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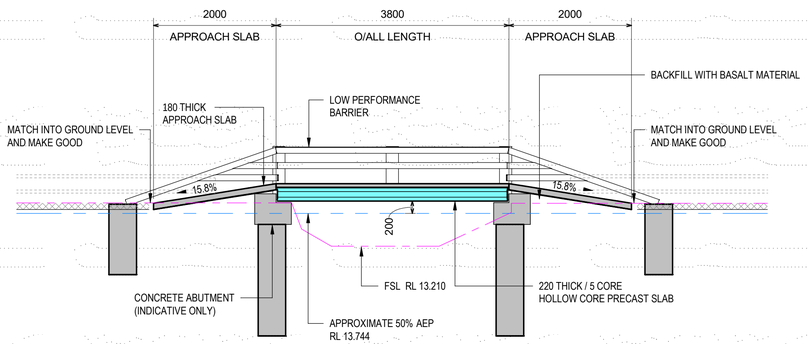

CU15 - ELEVATION

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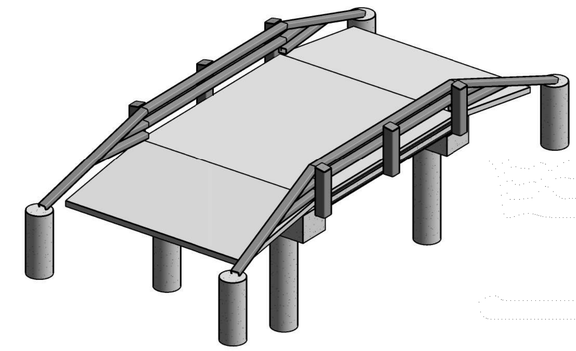

CU15 - 3D VIEW

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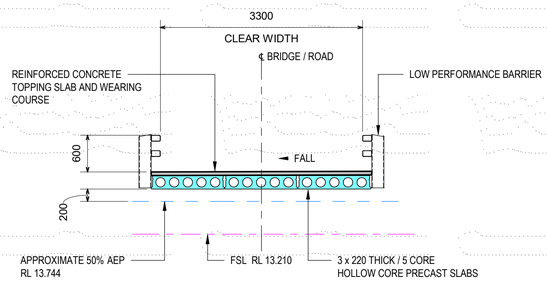

SECTION CA1 / CD03

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NOTE:

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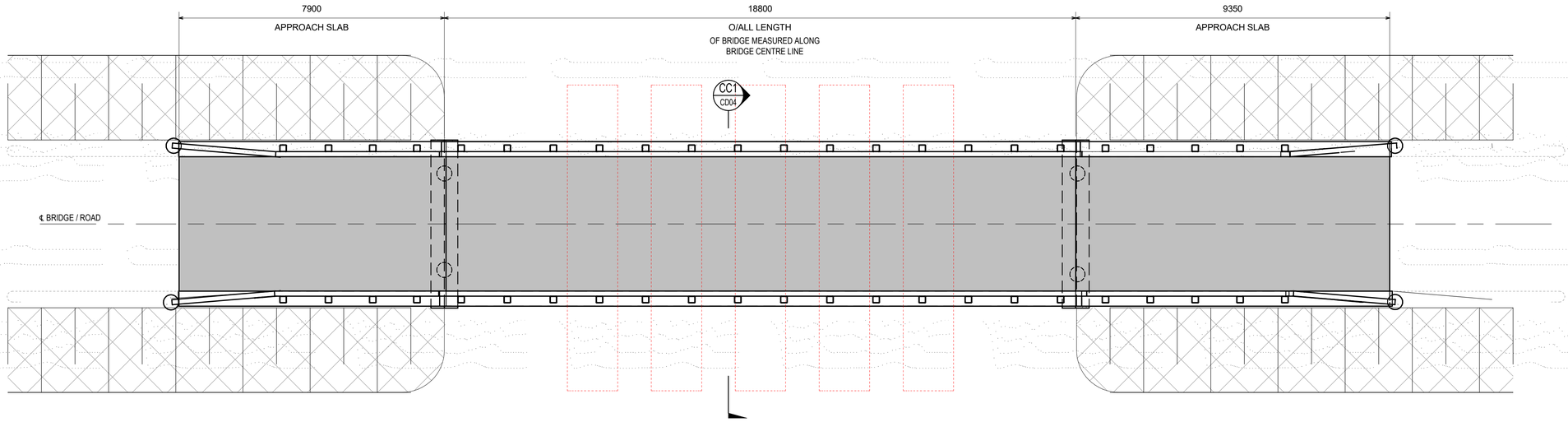
BRIDGE CONCEPTS

STRUCTURAL DRAWINGS

NORTH

DRAWING TITLE: CU15 - GENERAL ARRANGEMENT PLAN

TGM REF. No.:	SHEET:	ISSUE:
22800-01	CD03	02



CU16 - GENERAL ARRANGEMENT - PLAN

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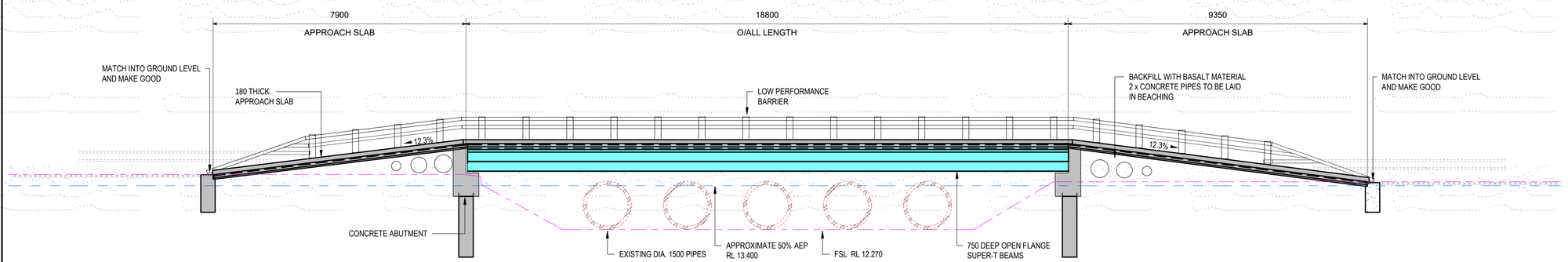

CU16 - ELEVATION

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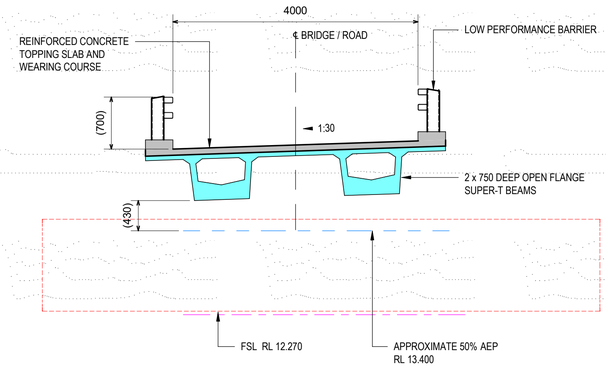

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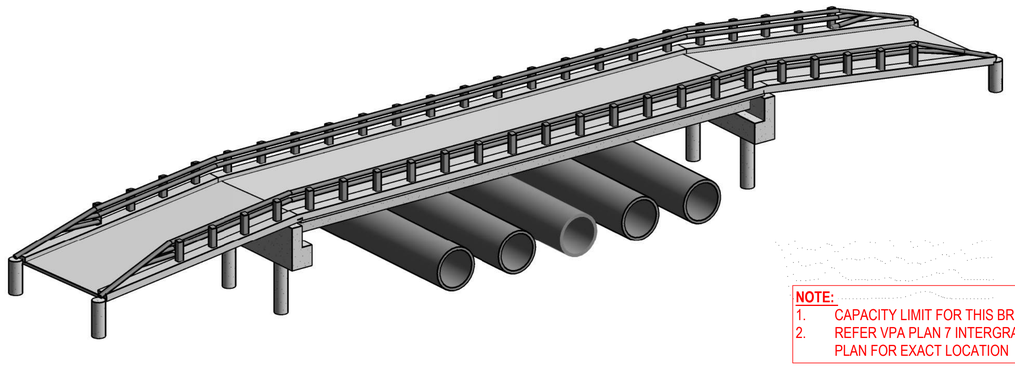

CU16 - 3D VIEW

SCALE:

NOTE:
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BRIDGE CONCEPTS

STRUCTURAL DRAWINGS

DRAWING TITLE: CU16 - GENERAL ARRANGEMENT PLAN

TGM REF. No.: 22800-01 | SHEET: CD04 | ISSUE: 02

Appendix B – Cost Estimate

Item	Description	Crossing A Length(m)	Width(m)	Depth(m)	Volume/Area/No	Unit	Rate ($)	Total Cost
Approach Work								
Concrete Work	180thick concrete on each side of bridge	2.00		0.18	0.72	sq.m	$ 329.00	$ 236.88
Formwork	Formwork to side faces	2.00		0.1	0.40	sq.m	$ 155.00	$ 62.00
Reinforcement	SL82 top and bottom				0.49	t	$ 2,500.00	$ 1,213.00
Balustrades	Low Performance, eaach side of approach	2.00			8.00	m	$ 300.00	$ 2,400.00
Pipes below approach	3xConcerete Pipes per Approach	3.590			21.54	m	$ 215.00	$ 4,631.10
Backfill Balast Material		2.000	3.590	0.250	1.80	cu.m	$ 165.00	$ 296.18
Bridge Deck								
Concrete Work	180thick concrete on each side of bridge	3.80	3.59	0.18	2.46	cu.m	$ 329.00	$ 807.88
Formwork	Formwork to side faces	3.80	3.59	0.1	1.36	cu.m	$ 172.00	$ 234.64
Reinforcement	SL82 top and bottom	3.80	3.59	0.1	0.24	t	$ 2,500.00	$ 606.50
Screed	60 thick screed	3.80	3.59		13.64	sq.m	$ 85.00	$ 1,159.57
Bearings	3 bearings per abutment				6.00	unit	$ 450.00	$ 2,700.00
Bridge Beam (inc member+crainage)	Hollowcore 220thick	3.80	3.59		40.93	sq.m	$ 770.00	$ 38,833.02
Balustrades	Low Performance, both sides of bridge	3.80			7.60	m	$ 300.00	$ 2,280.00
Abutments								
Excavations					5.74	cu.m	$ 199.20	$ 1,144.20
Concrete work	Abutment each side of bridge	0.80	3.59	1.0	5.74	cu.m	$ 329.00	$ 1,889.78
Concrete work	Abutment wall each side of bridge	0.20	3.59	0.3	0.43	cu.m	$ 329.00	$ 141.73
Formwork	All four(4) sides of abutment and wall	3.80	3.59		54.57	sq.m	$ 155.00	$ 8,458.04
Reinforcement	N16-100 all sides				0.36	t	$ 2,500.00	$ 908.00
Piles	2-600dia x 2000L per abutment	2.00			8.00	m	$ 210.00	$ 1,680.00
Additional Items								
Hoarding		200.000			200.00	m	$ 10.00	$ 2,000.00
						Construction Cost		**$ 71,682.52**
Builders Margin 12.5%								$ 8,960.32
35% Contingency								$ 25,088.88
3.25% Council fees								$ 2,329.68
2% Traffic management								$ 1,433.65
5% Survey and design								$ 3,584.13
4% Supervision and project management								$ 2,867.30
2.5% site establishment								$ 1,792.06
						Total Cost		**$ 117,738.54**

Item	Description	Crossing B Length(m)	Width(m)	Depth(m)	Volume/Area/No	Unit	Rate ($)	Total Cost
Approach Work								
Concrete Work	180thick concrete on each side of bridge	2.00		0.18	0.72	sq.m	$ 329.00	$ 236.88
Formwork	Formwork to side faces	2.00		0.1	0.40	sq.m	$ 155.00	$ 62.00
Reinforcement	SL82 top and bottom				0.49	t	$ 2,500.00	$ 1,213.00
Balustrades	Low Performance, eaach side of approach	2.00			8.00	m	$ 300.00	$ 2,400.00
Pipes below approach	3xConcerete Pipes per Approach	4.800			28.8	m	$ 215.00	$ 6,192.00
Backfill Balast Material		2.000	4.800	0.250	2.40	cu.m	$ 165.00	$ 396.00
Bridge Deck								
Concrete Work	180thick concrete on each side of bridge	8.90	4.80	0.18	7.69	cu.m	$ 329.00	$ 2,529.88
Formwork	Formwork to side faces	8.90	4.80	0.1	4.27	cu.m	$ 172.00	$ 734.78
Reinforcement	SL82 top and bottom	8.90	4.80	0.1	0.24	t	$ 2,500.00	$ 606.50
Screed	60 thick screed	8.90	4.80		42.72	sq.m	$ 85.00	$ 3,631.20
Bearings	4 bearings per abutment				4.00	unit	$ 450.00	$ 1,800.00
Bridge Beam (inc member+crainage, etc)	Hollowcore 220thick	8.90	4.80		128.16	sq.m	$ 770.00	$ 106,003.20
Balustrades	Low Performance, both sides of bridge	8.90			17.80	m	$ 300.00	$ 5,340.00
Abutments								
Excavations					7.68	cu.m	$ 199.20	$ 1,529.86
Concrete work	Abutment each side of bridge	0.80	4.80	1.0	7.68	cu.m	$ 329.00	$ 2,526.72
Concrete work	Abutment wall each side of bridge	0.20	4.80	0.3	0.58	cu.m	$ 329.00	$ 189.50
Formwork	All four(4) sides of abutment and wall	3.80	4.80		72.96	sq.m	$ 155.00	$ 11,308.80
Reinforcement	N16-100 all sides				0.36	t	$ 2,500.00	$ 908.00
Piles	3-600dia x 2000L per abutment	2.00			12.00	m	$ 210.00	$ 2,520.00
Additional Items								
Hoarding		200.000			200.00	m	$ 10.00	$ 2,000.00
							TOTAL COST	**$ 152,128.32**
Builders Margin 12.5%								$ 19,016.04
35% Contingency								$ 53,244.91
3.25% Council fees								$ 4,944.17
2% Traffic management								$ 3,042.57
5% Survey and design								$ 7,606.42
4% Supervision and project management								$ 6,085.13
2.5% site establishment								$ 3,803.21
							Total Cost	**$ 249,870.77**

Item	Description	Crossing C Length(m)	Width(m)	Depth(m)	Volume/Area/No	Unit	Rate ($)	Total Cost
Approach Work								
Concrete Work	180thick concrete on each side of bridge	7.90		0.18	2.84	sq.m	$ 329.00	$ 935.68
Formwork	Formwork to side faces	7.90		0.10	1.58	sq.m	$ 155.00	$ 244.90
Reinforcement	SL82 top and bottom				0.49	t	$ 2,500.00	$ 1,213.00
Balustrades	Low Performance, eaach side of approach	7.90			31.60	m	$ 300.00	$ 9,480.00
Pipes below approach	3xConcerete Pipes per Approach	4.200			25.2	m	$ 215.00	$ 5,418.00
Backfill Balast Material		7.900	4.70	0.85	31.56	cu.m	$ 165.00	$ 5,207.48
Bridge Deck								
Bridge Beam (inc member+crainage, etc)	2x750 Deep SuperT	18.80	4.70		265.08	sq.m	$ 1,096.00	$ 297,847.68
Abutments								
Excavations					74.26	cu.m	$ 199.20	$ 14,792.59
Concrete work	Abutment each side of bridge	7.90	4.70	1.00	74.26	cu.m	$ 329.00	$ 24,431.54
Concrete work	Abutment wall each side of bridge	0.20	4.70	0.30	0.56	cu.m	$ 329.00	$ 185.56
Formwork	All four(4) sides of abutment and wall	4.20	4.70		78.96	sq.m	$ 155.00	$ 12,238.80
Reinforcement	N16-100 all sides				0.36	t	$ 2,500.00	$ 908.00
Piles	3-600dia x 2000L per abutment	7.90			47.40	m	$ 210.00	$ 9,954.00
Additional Items								
Hoarding		400.00			400.00	m	$ 10.00	$ 4,000.00
						TOTAL COST	**$**	**386,857.23**
Builders Margin 12.5%							$	48,357.15
35% Contingency							$	135,400.03
3.25% Council fees							$	12,572.86
2% Traffic management							$	7,737.14
5% Survey and design							$	19,342.86
4% Supervision and project management							$	15,474.29
2.5% site establishment							$	9,671.43
						Total Cost	**$**	**635,412.99**