



Western Cape Government: DTPW Road Programme Management Contract C1157.02: Flood Damage Repairs to Structures in the Garden Route Area

Incident Report



						
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Table of Contents

1. INTRODUCTION	1
1.1 Background	1
1.2 Terms of Reference for this Report	1
1.3 Aim of the Appointment	1
1.4 Scope of Works.....	1
1.5 Traffic Volumes	2
1.5.1 Ø1.5m Armco culvert on road MR00355 at km 3.00	2
1.5.2 Ø2.0m Armco culvert on road MR00355 at km 3.77	2
1.5.3 Road slip on road MR00355 at km 7.95	2
1.5.4 1.6m wide x 1.2m high box culvert causeway on road DR01633 at km 3.35	2
1.5.5 Three Ø600mm concrete pipe culvert causeway on road DR01791 at km 1.59	2
1.5.6 Inlet and outlet protection works at six Ø450mm precast concrete pipe culvert + two 1.2m wide x 0.6m high box culvert causeway on road DR01639 at km 1.63	3
1.5.7 Missing bridge end-block on road MR00355 at km 8.67	3
1.5.8 Three Ø600mm precast concrete pipe culvert + four 1.2m wide x 0.9m high box culvert causeway on road DR01602 at km 8.48	3
1.5.9 Balustrade walls in Montagu Pass on DR01640 between km 7 and 10	3
1.6 Field Inspections	3
2. LIST OF STRUCTURES	4
2.1 Original Appointment – Priority A Sites.....	4
2.2 Priority B Sites to be possibly elevated to Priority A and added to current Scope of the Appointment.....	4
3. DESIGN & IMPLEMENTATION CONSIDERATIONS	5
3.1 Hydraulics	5
3.2 Inlet and outlet structures	6
3.3 Traffic Accommodation	6
3.4 Proposed Road Width for Causeways at low level river crossings	6
3.5 Approach slabs	7
3.6 Environmental	7
3.7 Topographical Survey	7
3.8 Geotechnical investigation	7
4. DISCUSSION	8
4.1 Original Appointment – Priority A sites	8
4.1.1 Ø1.5m Armco culvert on road MR00355 at km 3.00	8
4.1.2 Ø2.0m Armco culvert on road MR00355 at km 3.77	8
4.1.3 Road slip on road MR00355 at km 7.95	9
4.1.4 1.6m wide x 1.2m high box culvert causeway on road DR01633 at km 3.35	9
4.1.5 Three Ø600mm precast concrete pipe culvert causeway on road DR01791 at km 1.59	9



4.1.6	Inlet and outlet protection works at six Ø450mm precast concrete pipe culvert + two 1.2m wide x 0.6m high box culvert causeway on road DR01639 at km 1.63	10
4.2	Priority B sites to be Elevated to Priority A sites at discretion of the Client	11
4.2.1	Three Ø600mm precast concrete pipe culvert + four 1.2m wide x 0.9m high box culvert causeway on road DR01602 at km 8.48	11
4.2.2	Missing bridge end-block on road MR00355 at km 8.67	11
4.2.3	Balustrade walls in Montagu Pass on DR01640 between km 7 and 10	12
5.	RECOMMENDATIONS	12
5.1	Original Appointment – Priority A sites	12
5.1.1	Ø1.5m Armco culvert on road MR00355 at km 3.00	12
5.1.2	Ø2.0m Armco culvert on road MR00355 at km 3.77	12
5.1.3	Road slip on road MR00355 at km 7.95	12
5.1.4	1.6m wide x 1.2m high box culvert causeway on road DR01633 at km 3.35	12
5.1.5	Three Ø600mm precast concrete pipe culvert causeway on road DR01791 at km 1.59	12
5.1.6	Inlet and outlet protection works at six Ø450mm precast concrete pipe culvert + two 1.2m wide x 0.6m high box culvert causeway on road DR01639 at km 1.63	13
5.2	Priority B sites to be Elevated to Priority A sites at discretion of the Client	13
5.2.1	Three Ø600mm precast concrete pipe culvert + four 1.2m wide x 0.9m high box culvert causeway on road DR01602 at km 8.48	13
5.2.2	Missing bridge end-block on road MR00355 at km 8.67	13
5.2.3	Balustrade walls in Montagu Pass on DR01640 between km 7 and 10	13
5.3	Detail Design	13
5.4	Topographical Survey	13
5.5	Environmental Checklist	13
6.	COST ESTIMATE	14
	APPENDIX A: MINUTES OF BRIEFING MEETING	15
	APPENDIX B: PHOTOGRAPHS OF LISTED STRUCTURES	17
	B1: Original Appointment – Priority A sites	18
	B2: Priority B sites to be elevated to Priority A sites at discretion of Client	28
	APPENDIX C: PROPOSED STRUCTURES	32
	APPENDIX D: WCG DTPW STANDARD DRAWINGS	34
	APPENDIX E: EXTRACT FROM TRH17: 1988 – GEOMETRIC DESIGN OF RURAL ROADS	35

1. INTRODUCTION

1.1 Background

The Garden Route area experienced significant flooding due to heavy rains in November 2021. Numerous causeways in the George and Plettenberg Bay areas have overtopped with ensuing damage not only at the river crossing but also along the road since the road acts as a weir when the hydraulic capacity is exceeded if openings are too small. Frequent overtopping of these roads lead to repair work needed to be done by the Garden Route District Municipality (hereafter referred to as "DM") on a regular basis. An Armco culvert on the Seven Passes Road near Saasveld has failed causing the road to wash away and another Armco culvert approximately 770m away has failed partially.

1.2 Terms of Reference for this Report

Hatch was appointed by the Western Cape Government (hereafter referred to as "WCG") Transport and Public Works Road Programme Management department on 13 May 2022 to assess, design and monitor the repair work to roads, drainage and protection works with due consideration to the environmental impact.

A briefing meeting was held at the Hatch offices in Cape Town on 17 May 2022 with Wandie Olivier and Sardieq Slamdien. Refer to Annexure A for the Minutes of Meeting that sets out the details of the project.

1.3 Aim of the Appointment

This report describes the findings of the inspections, lists recommended repairs and provides preliminary design recommendations based on the visual assessment, as well as a high-level cost estimate based on previous projects of a similar nature. We have also included preliminary hydraulic information for each site. The report will be the basis to determine the final scope of the project as well as the structures to be included.

1.4 Scope of Works

The scope of work comprised Priority A sites identified in Sardieq Slamdien's email dated 17 May 2022 with accompanying KMZ file locating these sites. Japie Strydom of the DM requested that we inspect three additional Priority B sites which were shown by Ezron du Plessis of the DM. A subsequent email from the WCG, dated 25 May 2022, recommended that the causeway on DR1602 at km 6.20 be elevated from Priority B to Priority A; however, this has not been officially added to the current scope of works.

1.5 Traffic Volumes

1.5.1 Ø1.5m Armco culvert on road MR00355 at km 3.00

Table 1 – Daily Traffic Volumes along MR355

Traffic Designation	Number
Light Vehicles	1814
Heavy Vehicles	39
Taxis	18
Buses	36
AADT	1907

1.5.2 Ø2.0m Armco culvert on road MR00355 at km 3.77

Same Daily Traffic Volumes as provided in Table 1.

1.5.3 Road slip on road MR00355 at km 7.95

Table 2 – Daily Traffic Volumes along MR355

Traffic Designation	Number
Light Vehicles	555
Heavy Vehicles	15
Taxis	1
Buses	8
AADT	579

1.5.4 1.6m wide x 1.2m high box culvert causeway on road DR01633 at km 3.35

Table 3 – Daily Traffic Volumes along DR1633

Traffic Designation	Number
Light Vehicles	87
Heavy Vehicles	25
Taxis	0
Buses	2
AADT	114

1.5.5 Three Ø600mm concrete pipe culvert causeway on road DR01791 at km 1.59

Table 4 – Daily Traffic Volumes along DR1791

Traffic Designation	Number
Light Vehicles	113
Heavy Vehicles	13
Taxis	2
Buses	1
AADT	129

1.5.6 Inlet and outlet protection works at six Ø450mm precast concrete pipe culvert + two 1.2m wide x 0.6m high box culvert causeway on road DR01639 at km 1.63

Table 5 – Daily Traffic Volumes along DR1639

Traffic Designation	Number
Light Vehicles	59
Heavy Vehicles	10
Taxis	0
Buses	5
AADT	74

1.5.7 Missing bridge end-block on road MR00355 at km 8.67

Same Daily Traffic Volumes as provided in Table 2.

1.5.8 Three Ø600mm precast concrete pipe culvert + four 1.2m wide x 0.9m high box culvert causeway on road DR01602 at km 8.48

Table 6 – Daily Traffic Volumes along DR1602

Traffic Designation	Number
Light Vehicles	126
Heavy Vehicles	27
Taxis	0
Buses	3
AADT	156

1.5.9 Balustrade walls in Montagu Pass on DR01640 between km 7 and 10

Table 7 – Daily Traffic Volumes along DR1640

Traffic Designation	Number
Light Vehicles	140
Heavy Vehicles	16
Taxis	1
Buses	0
AADT	157

1.6 Field Inspections

Field inspections were carried out on 18 and 19 May 2022 by Dawie Malan and Pieter Smit to evaluate and assess the flood damage, accompanied by Ezron du Plessis of the DM.

2. LIST OF STRUCTURES

2.1 Original Appointment – Priority A Sites

The WCG have provided the following list in letter reference TPW16/6/4/1/1- C1157.02 dated 13 May 2022.

Table 8: List of Elements forming part of Original Appointment – Priority A Sites

Road No.	Km Dist.	GPS Coordinates	Element
MR00355	3.00	33° 58' 05.04" S 22° 30' 57.65" E	Ø1.5m Armco culvert
MR00355	3.77	33° 58' 05.32" S 22° 31' 28.01" E	Ø2.0m Armco culvert
MR00355	7.95	33° 57' 56.60" S 22° 33' 26.82" E	Road slip
DR01633	3.35	33° 56' 15.06" S 22° 14' 34.11" E	A single 1.6m wide x 1.2m high box culvert
DR01791	1.59	34° 00' 04.57" S 23° 19' 27.98" E	Three Ø600mm precast concrete pipe culverts
DR01639	1.63	33° 55' 56.80" S 22° 22' 40.04" E	Six Ø450mm precast concrete pipe culverts at riverbed level with two additional 1.2m wide x 0.6m high box culverts on top of the pipe culverts

2.2 Priority B Sites to be possibly elevated to Priority A and added to current Scope of the Appointment

Table 9: List of Elements forming part of Priority B Sites

Road No.	Km Dist.	GPS Coordinates	Element
DR01602	8.48	33° 57' 35.20" S 22° 14' 28.80" E	Three Ø600mm precast concrete pipe culverts and four 1.2m wide x 0.9m high box culverts
MR00355	8.67	33° 57' 53.87" S 22° 33' 41.26" E	Missing bridge end-block
DR01640	7.55	33° 53' 42.49" S 22° 25' 12.60" E	3.6m long x 600 mm wide x 600mm high stone packed barrier wall
DR01640	7.63	33° 53' 40.99" S 22° 25' 13.95" E	12m long x 600 mm wide x 700mm high stone packed barrier wall
DR01640	7.87	33° 53' 36.32" S 22° 25' 17.47" E	14.1m long x 600 mm wide x 500-700mm high stone packed barrier wall
DR01640	8.05	33° 53' 33.47" S 22° 25' 22.56" E	6.2m long x 600 mm wide x 600mm high stone packed barrier wall
DR01640	9.84	33° 53' 13.38" S 22° 25' 54.07" E	3.6m long x 600 mm wide x 900mm high stone packed barrier wall

3. DESIGN & IMPLEMENTATION CONSIDERATIONS

3.1 Hydraulics

The hydraulic design will be based on the Sanral Drainage Manual 6th edition. The design flood return period will be determined by the Class of road and the size of the flood based on a 20-year return period based on Figure 8.2.

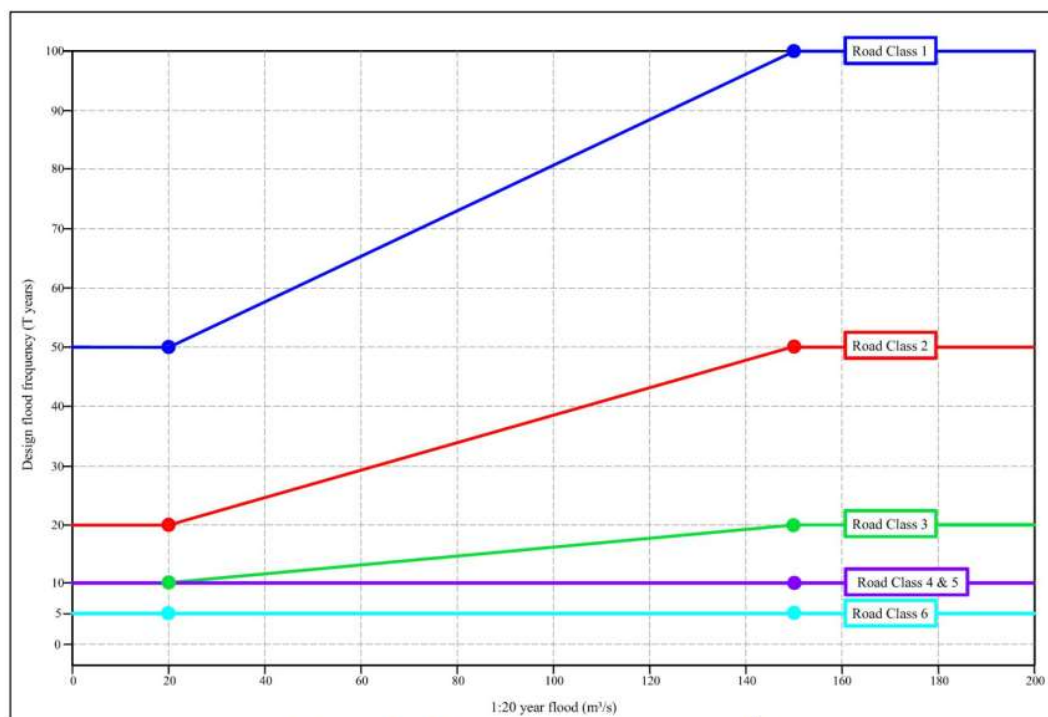


Figure 8.2: Design flood frequency estimate (Revised in 6th edition)

The proposed road classes are as follows:

Table 10: Proposed Road Classes

Road no	Road Class	Design criteria
MR355	R3	QT for a H/D < 1.2 Q2T for a H/D < 2.0
DR1633	R4	QT with water overtopping not exceeding guide block height
DR1791	R4	QT with water overtopping not exceeding guide block height
DR1639	R4	QT with water overtopping not exceeding guide block height

Based on prior knowledge of the design flood of the culvert on MR355 at km 3.77 the 20-year flood was 9m³/s, thus all hydraulic structures will be designed for a 10-year return period for the QT flood.

Preliminary hydraulic data have been determined for each site and are summarized below.

Table 11: Preliminary Hydraulic Data

Road no	Km marker	Catchment Area (m2)	1:5 year Flood	1:10 year Flood
MR355	3.00	0.4	TBC	TBC
DR1633	3.35	11.5	TBC	TBC
DR1639	1.63	3.2	TBC	TBC
DR1791	1.59	20.7	TBC	TBC
DR1602	8.48	21.4	TBC	TBC

3.2 Inlet and outlet structures

Standard inlet and outlet wing walls and apron slabs will be provided.

3.3 Traffic Accommodation

Table 12: Proposed Traffic Accommodation

Road no	Km marker	Proposed traffic accommodation
MR355	3.00	Road to remain open for two-way traffic
MR355	7.95	Half-width construction
DR1633	3.35	Temporary deviation road on upstream side 4.0m wide
DR1639	1.63	Temporary deviation road on upstream side 4.0m wide
DR1791	1.59	Temporary deviation road on downstream side 4.0m wide
DR1602	8.48	Temporary deviation road on upstream side 4.0m wide
MR355	8.67	Half-width construction
DR1602	7.55 to 9.84	Closing of shoulder at discrete lengths up to 20m long

3.4 Proposed Road Width for Causeways at low level river crossings

WCS60/1/D1 provides the WCG details for "Rural Structure Standards widths" for bridges, agricultural overpasses and Low Level bridges. (See Appendix D). The only standard for a low level crossing is for a single lane and no provision is made for two-way traffic, except that the width can be increased to 6.0m based on agricultural machinery requirements, as some machinery is too

wide to pass over the 4.0m clear width structure. The 4.0m width is derived from 3.4m lane width with 2 x 0.3m shoulders.

TRH17 Geometric Design of Rural Roads allows for a minimum lane width of 3.1m, thus for two-way traffic a minimum of 6.2m. Extract provided in Appendix E.

It is proposed that we comply with both your "Rural Structure Standard Widths" varying from 4.0m to 6.0m and the TRH17 minimum of 6.2m thus complying with both a structural standard and a geometric standard.

One of the big problems of the low level structures is debris blockages and the wider the structure is, the more difficult it is to clean and the more frequent the blockages are; the result is that it is not frequently maintained. One should thus try to make the structure as narrow as possible, thus the recommendation of 6.2m clear width plus 2 x 0.34m guide blocks on the sides.

3.5 Approach slabs

Concrete approach slabs are often used at either end of vented low level river crossings (causeways). In our experience these slabs are often under-scoured during floods which overtop the structure and then it is difficult, a time-consuming process and expensive to repair or replace the slabs. In our view it is preferably to use earth approaches which can be repaired quickly and cheaply if it washes away. It is proposed to protect the batters with erosion protection measures, eg gabions, if required.

3.6 Environmental

An Environmental Checklist must be completed to determine whether the proposed activities are listed in terms of the NEMA regulations. The Checklist must be submitted to the Competent Environmental Authority and a response must be received from them for the correct way forward in terms of environmental approvals. Sharples Environmental Services was appointed for the checklist and feedback is expected at about 30 August 2022.

3.7 Topographical Survey

African Consulting Surveyors was appointed for a LiDar topographical survey of the five river crossings and provided contour drawings sufficient for Hecras modelling of the proposed structures for the detail design.

3.8 Geotechnical investigation

No geotechnical investigation is envisaged.

At MR355 at km 3.0 it is proposed to jack a new culvert over the existing culvert and a limited risk is that boulders or rock may be present, but a geotechnical investigation will not reduce that risk materially. One will also infer that similar bedding conditions will be present at km 3.00 which was present at km 3.77.

The other culvert structures will either be founded on bedrock or have a raft foundation.

4. DISCUSSION

This section should be read in conjunction with photographs in Appendix B.

4.1 Original Appointment – Priority A sites

4.1.1 Ø1.5m Armco culvert on road MR00355 at km 3.00

The culvert is corroded badly, especially the invert where there are not steel in most sections, thus the culvert has lost its structural integrity. The upstream side of the inlet works is in a good condition, but the last section of the Armco culvert washed away and collapsed due to erosion. There is no outlet structure visible. It appears as if the outlet side of the pipe is considerably higher than the riverbed into which it exits.

Repair options:

1. Repair Armco culvert to the WCG Standard drawing no. WSC/60/9/D1 (See Appendix D)
2. Replace the Armco culvert
 - a. By excavating the culvert and laying a new concrete pipe
 - b. Jacking a concrete pipe over the existing Armco and subsequently removing the Armco culvert.

New inlet and outlet works consisting of wing walls and an apron slab is required.

Discussion:

Option 1 is the cheapest option, but the Armco has lost its structural integrity and this process will require cutting the remaining steel at the invert level further reducing its load carrying ability temporarily during construction which causes danger to the workers. The diameter of the pipe will be marginally reduced. The biggest concern is that the culvert is badly corroded everywhere and has no corrosion protection remaining, thus the life expectancy of the Armco culvert is limited.

Option 2 (a) will require the road to be closed for a period of minimum 30 days which Japie Strydom of the DM requested should be a last resort as the Saasveld forestry department has already been affected for a period of 6 months due to works being carried out at km 3.77. It would be difficult to build a temporary deviation road due to the deep valley and this will destroy a large area of the indigenous vegetation.

Option 2 (b) will not require the closing of the road nor a temporary deviation road and may be cheaper than Option 2 (a) as earthworks and road building operations will not be required.

4.1.2 Ø2.0m Armco culvert on road MR00355 at km 3.77

This work was done departmentally by the WCG and the road would have been opened by end May 2022. The repair consisted of a 1800mm concrete spigot and socket pipe with concrete upstream and downstream inlet and outlet works consisting of wing walls, apron slabs, cut-off beams and a downstream stilling basin for erosion protection. All this work will be completed departmentally unless the client advises that certain components must be included in this commercial project.

The road just upstream of the repaired culvert is in a bad condition and may collapse during a high rainfall event, causing the debris to block the opening of the new culvert. Refer to the last photo in the Appendix for this structure. This structure does not belong to the WCG, but its collapse poses a risk to the integrity of the road fill.

4.1.3 Road slip on road MR00355 at km 7.95

A 15m long section of road has been affected by road slip. There is an existing 2.2m high rock wall on the edge of the road.

We recommend that the affected area is excavated and re-built in layers of 500mm thick reinforced earth. Once the road has been reinstated, either re-use the existing rocks to re-build the wall along the face of the fill material, or alternatively use gabions, to protect the road edge from erosion.

4.1.4 1.6m wide x 1.2m high box culvert causeway on road DR01633 at km 3.35

The existing concrete causeway structure is 30m long and 8m wide and includes one drainage opening of 1600mm wide x 1200mm high. The structure has return walls which are underscoured. Due to the undersized drainage opening the structure acts as a weir during larger rainfall events causing wide erosion on the downstream side.

It is recommended to replace this structure with a causeway with adequate drainage openings so that the design flood can pass under the structure with limited overtopping so that it will still be safely trafficable. A visual estimate is that an in situ reinforced concrete structure with two 6m wide x 1.5m high openings will be required. A 6.2m road width between guide blocks is recommended.

New inlet and outlet works, consisting of wing walls and an apron slab, are required. No approach slabs are proposed but the current approach slabs may be retained.

4.1.5 Three Ø600mm precast concrete pipe culvert causeway on road DR01791 at km 1.59

The existing concrete causeway is 20m long x 6.1m wide with three Ø600mm pipes which is submerged permanently thus it does not contribute to hydraulic capacity. This is in essence a drift structure. During the floods of November 2021, a part of the unreinforced concrete deck slab was lifted by the flood action. The structure has water pools on both sides of the road and this appears to be a permanent feature with water lilies growing in the pond on the downstream side.

Local farmers (Henk Stroebe – 072 628 6232 and Peter Schuster – 082 330 3030), whom we met during the inspection, confirmed that flooding occurs about 3 times per year and that the road is inaccessible to traffic for periods up to 5 days during high rainfall events.

The problem can be alleviated if the river can be cleaned of vegetation, but it will not solve the problem and such cleaning operations will need to be done regularly and would have to include areas outside the road reserve.

Repair options:

1. Repair the causeway slab by reinstating the missing top slab to prevent vehicle damage.
2. Replace the structure with a causeway with larger openings and lift the top deck level marginally to increase the hydraulic capacity marginally.

3. Replace the structure with a causeway which is considerably higher than the current structure with adequately sized openings to cater for the design flood and the overgrown nature of the river. The gravel road and the surfaced road will have to be raised for about 100m on both sides of the causeway. A visual estimate is that an in situ reinforced concrete structure with two cells 6m long x 1.5m high opening will be required. This will raise the road level by about 1.4m. Detail hydraulic analysis will be required to provide more accurate proposals.

Discussion:

Option 1 and 2 would not improve the problem that the structure is inundated for periods following a high rainfall event. Option 1 is cheap and option 2 has a bad benefit-to-cost ratio. Option 3 will resolve the problem permanently.

Options 2 and 3 will require new inlet and outlet works, consisting of wing walls and an apron slab. A 6.2m road width between guide blocks is recommended. No approach slabs are proposed.

4.1.6 Inlet and outlet protection works at six Ø450mm precast concrete pipe culvert + two 1.2m wide x 0.6m high box culvert causeway on road DR01639 at km 1.63

The existing structure is 5.1m long and 4.6m wide and consist of an older structure at the bottom of six Ø450mm concrete pipes and a later structure consisting of two 1200mm wide x 600mm high box culverts which was built on top of the older structure. The pipes are eroded so that the invert is mostly non-existent. It appears that the last flood caused the structure to overtop, and that this water eroded the downstream side wider than the confined riverbed upstream and further downstream as it acted as a weir structure.

Rip rap was placed on the downstream side, and this will alleviate future scouring due to overtopping. The request was to provide erosion protection works.

Repair options:

1. Upstream and downstream erosion works can be provided consisting of wing walls, apron slabs and cut-off beams.
2. The structure can be replaced with a causeway with adequately sized openings for the design flood. A visual estimate is that an in situ reinforced concrete structure with an single cell of 5m wide x 1.4m high will be required.
3. Do nothing.

Discussion:

The rip rap which was recently placed on the downstream side will reduce scour and this can be improved by placing more rip rap. The basic problem, i.e., the drainage openings are too small for the catchment area and small debris would easily block these small drainage openings, will remain. These problems will not persist if a structure with adequate large draining openings is provided. Should option no. 1 be implemented, and the causeway must ever be replaced due to collapsing pipes, the new works will make it very difficult to carry out these repair works and the road width will remain at 4.6m unless the inlet and outlet structures are demolished.

Option 2 will require new inlet and outlet works, consisting of wing walls and an apron slab. A 6.2m road width between guide blocks is recommended.

The flood fence on the downstream side is missing and needs to be replaced.

4.2 Priority B sites to be Elevated to Priority A sites at discretion of the Client

Japie Strydom of the District Municipality requested that the following sites be investigated during our site inspection and that design proposals be provided in case the sites classification can be elevated to Priority A site.

4.2.1 Three Ø600mm precast concrete pipe culvert + four 1.2m wide x 0.9m high box culvert causeway on road DR01602 at km 8.48

The existing causeway is 22m long and 4.2m wide and includes three Ø600mm pipes and four 1200mm wide x 900mm high box barrels. The upstream and downstream sides are scoured to 500mm and 1000mm respectively below the invert levels of the drainage openings. During the November 2021 flood the George side approach road was washed away for a length of 15m. From initial investigation it appears as if the bedrock is about 1000mm below the invert level of the drainage openings.

The DM reported that the large grain and milk trucks regularly falls off the causeway as the structure is too narrow just past the sharp bend on the George side. The DM improved the bend, but the problem persists according to Japie Strydom of the DM. The structure is unsafe when it overtops as it does not have guide blocks.

Repair options:

1. The structure can be locally widened on the side of the sharp bend and guide blocks can be added
2. The structure can be replaced with a causeway with adequately sized drainage openings for the design flood. A visual estimate is that an in situ reinforced concrete causeway with three cells of approximate 6m wide by 1.5m high will be required. and it can be widened to 6.2m between guide blocks, unless the detail design of the safe turning circle and sweep of trailers determine that an even wider structure is required locally.

Option 2 will require new inlet and outlet works, consisting of wing walls and an apron slab.

4.2.2 Missing bridge end-block on road MR00355 at km 8.67

This bridge is named the Silver River bridge.

One of the end blocks and part of the balustrade, which are both constructed in unreinforced concrete, was knocked down by vehicle impact. The bridge straddles a very deep gorge and therefore road users' safety is endangered.

The only repair option available is to replace the end-block with the same geometric dimensions but to use reinforced concrete to make it more robust.

This structure is not part of the current scope of work, but as the structure is also on MR355 the writer wishes to remind the reader of the damage.

4.2.3 Balustrade walls in Montagu Pass on DR01640 between km 7 and 10

There are five sections where the dry-stack wall is missing with the following section lengths: 4m, 12m, 14m, 6m and 4m. The wall is 600mm wide and 700mm high with a thin layer of mortar on the top surface. The pass is dangerous to road users where the balustrade wall is missing.

These defects do not form part of our current appointment; however, the Garden Route DM have requested that we visit these sites at the same time of our initial site visit.

A combined length of 40m of dry-stack wall needs to be reinstated using existing rocks in the vicinity. We recommend that mass concrete is used to bind these rocks together whilst ensuring that the mass concrete is not visible on the external faces of the wall.

We further recommend that the road is re-gravelled in the near future as signs are visible that the foundation to this wall is starting to be undermined in localised areas.

5. RECOMMENDATIONS

5.1 Original Appointment – Priority A sites

5.1.1 Ø1.5m Armco culvert on road MR00355 at km 3.00

Replace the Armco culvert by jacking a concrete pipe over the existing Armco and subsequently remove the Armco culvert.

New inlet and outlet works, consisting of wing walls and an apron slab, are required.

5.1.2 Ø2.0m Armco culvert on road MR00355 at km 3.77

This work was done departmentally by the WCG. Client to confirm with DM whether any works are outstanding that has to be included in this Contract.

The culvert structure immediately upstream of the culvert must be investigated and a decision taken what actions are required or if no action is required.

5.1.3 Road slip on road MR00355 at km 7.95

Repair slip with reinforced earth complete with a screen wall, consisting of stone, to protect the reinforcement fabric.

5.1.4 1.6m wide x 1.2m high box culvert causeway on road DR01633 at km 3.35

Construct a new causeway with adequate drainage openings (visual estimate of 2 cells 6m wide x 1.5m high). A 6.2m road width between guide blocks is recommended.

New inlet and outlet works, consisting of wing walls and an apron slab, are required.

5.1.5 Three Ø600mm precast concrete pipe culvert causeway on road DR01791 at km 1.59

Construct a new causeway with adequately sized openings (visual estimate of 2 cells 6m wide x 1.5m high). A 6.2m road width between guide blocks is recommended.

New inlet and outlet works, consisting of wing walls and an apron slab, are required.

The gravel road and the surfaced road will have to be raised for about 100m on both sides of the causeway, which will possibly require some modification of the tow accesses on the eastern side.

5.1.6 Inlet and outlet protection works at six Ø450mm precast concrete pipe culvert + two 1.2m wide x 0.6m high box culvert causeway on road DR01639 at km 1.63

Construct a new causeway with adequately sized openings (visual estimate of 1 cell 5m wide x 1.4m high). A 6.2m road width between guide blocks is recommended.

New inlet and outlet works, consisting of wing walls and an apron slab, are required.

The flood fence on the downstream side is missing and needs to be replaced.

5.2 Priority B sites to be Elevated to Priority A sites at discretion of the Client

5.2.1 Three Ø600mm precast concrete pipe culvert + four 1.2m wide x 0.9m high box culvert causeway on road DR01602 at km 8.48

Construct a new causeway with adequately sized openings (visual estimate of 3 cells 6m wide x 1.5m high). A 6.2m road width between guide blocks is recommended unless the detail design of the safe turning circle and sweep of trailers determine that a wider structure locally at the side of the sharp bend is required.

New inlet and outlet works, consisting of wing walls and an apron slab, are required; but this may be omitted if base rock is at riverbed level.

5.2.2 Missing bridge end-block on road MR00355 at km 8.67

Replace missing end-block (of the same geometric dimensions) with a reinforced concrete structure.

5.2.3 Balustrade walls in Montagu Pass on DR01640 between km 7 and 10

A combined length of 40m of dry-stack wall needs to be reinstated using existing rocks in the vicinity.

5.3 Detail Design

A detailed design to be carried out during the next phase to confirm hydraulic data and structural sizes.

5.4 Topographical Survey

Appoint African Consulting Surveys for a LiDAR topographical survey of the five sites where hydraulic structures are proposed. Pierre Spence of WCG surveying department approved the quotation and technical requirements for a cost of R83 000 ex VAT.

5.5 Environmental Checklist

Appoint Sharples Environmental Services to prepare the Environmental Checklist at a cost of R28 000 excl. VAT which was agreed to by Sardieq Slamdien by email dated 11 July 2022.

6. COST ESTIMATE

Contracts of a similar nature were used to estimate the costs for this project. The components of the estimated cost include the structural costs, road costs and General Items.

Table 13: Cost estimate

No	Road No.	Km Dist.	Proposed Structure	Estimated Cost
6.1 Original Appointment – Priority A sites				
6.1.1	MR00355	3.00	New jacked concrete pipe	R 2,640,000.00
6.1.2	MR00355	3.77	New concrete pipe (completed departmentally)	R -
6.1.3	MR00355	7.95 to 7.96	15m long road slip repair	R 400,000.00
6.1.4	DR01633	3.35	New causeway	R 1,180,000.00
6.1.5	DR01791	1.59	New causeway	R 3,770,000.00
6.1.6	DR01639	1.63	New causeway	R 900,000.00
6.2 Priority B sites to be Elevated to Priority A sites at discretion of the Client				
6.2.1	DR01602	8.48	New causeway	R 950,000.00
6.3.1	MR00355	8.67	New bridge end-block	R 40,000.00
6.3.2	DR01640	7.55 to 9.84	New 40m long dry-stack balustrade wall	R 120,000.00
Total Structures				R 10,000,000.00
P&G (50%)				R 5,000,000.00
Sub Total 1				R 15,000,000.00
Day works				R 50,000.00
Total				R 15,050,000.00
VAT				R 2,257,500.00
Estimate Contract Sum				R 17,307,500.00

Note: The General Item cost for this type of project is high due to the small quantities of scheduled work, the different location and the fact that large construction teams cannot be used. We used actual costs from previous projects, and the General Item cost varied from 50% to 60% on these.

APPENDIX A: MINUTES OF BRIEFING MEETING



From: Malan, Dawie
Sent: Tuesday, May 17, 2022 10:16 AM
To: Sardieg.Slamdien@westerncape.gov.za
Cc: Wandie Olivier; Manchip, Chris; Smit, Pieter
Subject: C1157.02 Garden Route Flood Damage

Hi Sardieg

Thank you very much for the briefing session this morning at our office.

Attendance:
Dawie Malan
Sardieg Slamdien
Wandie Olivier

Scope of work:

6 sites

One site already completed construction by GRDM

Area: George & Plettenberg Bay

- Functional road class
 - o MR 355 – class 3 (proposed)
 - o Other roads (Class 4)
 - o Hatch will finalize proposal
- KMZ file (Google Earth) of site positions for hydraulic calculations before site visit

C-contract

Hatch to appoint surveyor, ECO, OHS

Programme

- 2 weeks for incident report. Intend to visit site between 23 & 27 May. Probably 2 or 3 days
-

Incident Report

- Stage 1 (status quo, repair proposal, Estimated cost, Detail design – programme)
- Submit 2 weeks after site visit
- Information required

Sardieg & Wandie: Thank you very much for the appointment; it is greatly appreciated.

Regards

Dawie Malan, Pr Eng
Senior Engineer/Structures & Bridges

Tel: +27 (0) 21 911 5823

Fax: +27 (0) 21 911 5824

Cell: +27 (0) 84 608 9815

2nd Floor, False Bay Building, Tygerberg Park, 163 Uys Krige Drive, Platteklouf, Cape Town, 7500, South Africa

www.hatch.co.za

HATCH

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APPENDIX B: PHOTOGRAPHS OF LISTED STRUCTURES

B1: Original Appointment – Priority A sites

B1.1: Ø1.5m Armco culvert on road MR00355 at km 3.00



Road MR00355 at km 3.00



Upstream – looking away from culvert



Upstream – looking towards culvert



Head fall and culvert inlet



Severe corrosion to invert of Armco culvert



Downstream section of the Armco culvert washed away and collapsed due to erosion



Downstream section of the Armco culvert washed away and collapsed due to erosion



Downstream section of the Armco culvert washed away and collapsed due to erosion



Downstream – looking towards culvert

B1.2: Ø2.0m Armco culvert on road MR00355 at km 3.77



Road MR00355 at km 3.77; upstream on RHS.
Backfilling in progress.



Road MR00355 at km 3.77; upstream on LHS.
Backfilling in progress.



Downstream – looking away from culvert



Downstream – looking towards culvert



Downstream – looking towards culvert. Headwall construction in progress.



Inside newly installed pipe culvert



Upstream – looking towards culvert



Upstream – looking away from culvert



Existing Armco culvert on private road upstream of MR00355 at risk of collapse. May cause damage to MR00355 if this happens.

B1.3: Road slip on road MR00355 at km 7.95



Road slip on RHS at MR00355 at km 7.95



Road slip on RHS at MR00355 at km 7.95



Close-up view of road slip



Close-up view of road slip



2.2m high rock wall on the edge of the road



Close-up view of rock wall

B1.4: 1.6m wide x 1.2m high box culvert causeway on road DR01633 at km 3.35



Road DR01633 at km 3.35; upstream on LHS.



Road DR01633 at km 3.35; upstream on RHS.



Road DR01633 at km 3.35; upstream on RHS.



Upstream – looking away from culvert



Upstream – looking towards culvert



Upstream – looking towards culvert



Corrosion visible to inside of causeway structure



Downstream – looking away from culvert



Downstream – looking away from culvert



Downstream – looking towards culvert



Downstream – looking towards culvert



Downstream – looking towards culvert



Downstream – looking towards culvert

B1.5: Three Ø600mm precast concrete pipe culvert causeway on road DR01791 at km 1.59



Road DR1791 at km 1.59; upstream on RHS.



Road DR1791 at km 1.59; upstream on RHS.



Road DR1791 at km 1.59; upstream on LHS. Debris from previous flood trapped against fence.



Debris from previous flood trapped against fence on downstream side of road.



Water ponding downstream of drift



Water ponding downstream of drift



Water ponding upstream of drift. Damage to deck caused during previous flood.



Water ponding upstream of drift. Damage to deck caused during previous flood.



Damage to deck and pipe culvert caused during previous flood.

B1.6: Inlet and outlet protection works at six Ø450mm precast concrete pipe culvert + two 1.2m wide x 0.6m high box culvert causeway on road DR01639 at km 1.63



Road DR1639 at km 1.63; upstream on LHS.



Road DR1639 at km 1.63; upstream on RHS.



Rip rap has recently been placed on the downstream side to reduce scour



Rip rap has recently been placed on the downstream side to reduce scour



Downstream – looking towards culvert. Flood fence missing.



Downstream – looking towards culvert. Flood fence missing.



Upstream – looking away from culvert



Upstream – looking towards culvert



Severe corrosion to invert of pipe culvert

B2: Priority B sites to be elevated to Priority A sites at discretion of Client

B2.1: Three Ø600mm precast concrete pipe culvert + four 1.2m wide x 0.9m high box culvert causeway on road DR01602 at km 8.48



Road DR1602 at km 8.48; upstream on RHS.



Road DR1602 at km 8.48; upstream on LHS.



Upstream – looking away from culvert



Upstream – looking towards culvert



Downstream – looking away from culvert



During the November 2021 flood the George side approach road was washed away for a length of 15m. This portion of road has been repaired and widened



Downstream – looking away from culvert



Downstream – looking towards culvert



Downstream – looking towards culvert

B2.2: Missing bridge end-block on road MR00355 at km 8.67



One of the end-blocks and part of the balustrade to the Salt River bridge on road MR00355 at km 8.67 was knocked down by vehicle impact. This is on the RHS when approaching the bridge from Saasveld side.



One of the end-blocks and part of the balustrade to the Salt River bridge on road MR00355 at km 8.67 was knocked down by vehicle impact. This is on the RHS when approaching the bridge from Saasveld side.



Remains of the damaged end-block and balustrade



Image of existing end-block on opposite side of the bridge

B2.3: Balustrade walls in Montagu Pass on DR01640 between km 7 and 10



Image of existing dry-stack balustrade wall in Montagu Pass on road DR1640



Damage to dry-stack balustrade wall on DR1640 at km 7.55



Damage to dry-stack balustrade wall on DR1640 at km 7.63



Damage to dry-stack balustrade wall on DR1640 at km 7.87



Damage to dry-stack balustrade wall on DR1640
at km 7.87



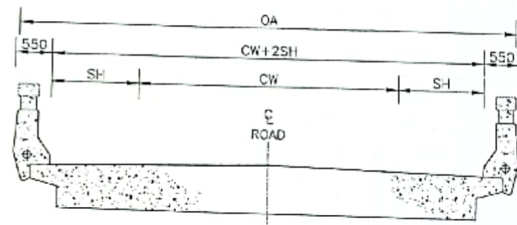
Damage to dry-stack balustrade wall on DR1640 at
km 9.84

APPENDIX C: PROPOSED STRUCTURES

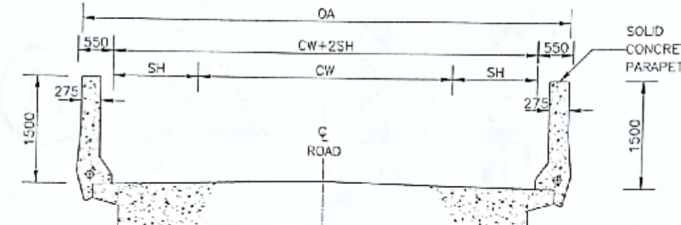
Typical Causeway



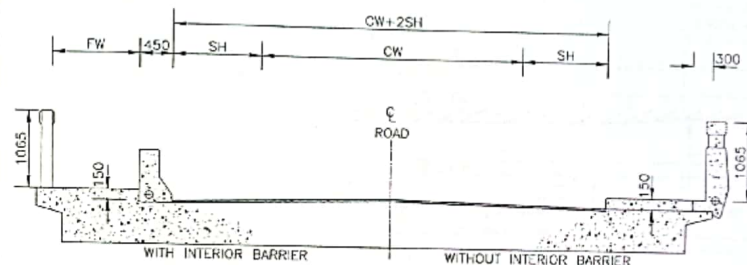
APPENDIX D: WCG DTPW STANDARD DRAWINGS



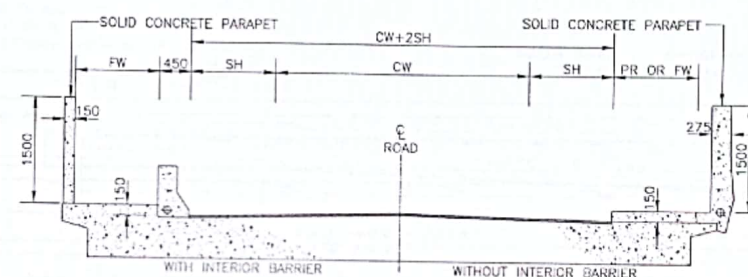
CROSS-SECTION TYPE B1



CROSS-SECTION TYPE R1

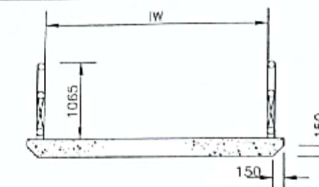


CROSS-SECTION TYPE B2
TYPE B: ROAD/ROAD AND ROAD/RIVER BRIDGES



CROSS-SECTION TYPE R2
TYPE R: ROAD/RAIL BRIDGES

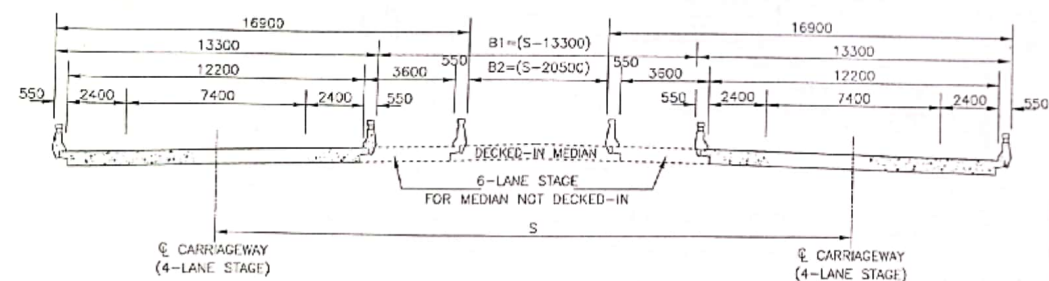
- NOTES :
1. PROVINCIAL TRUNK ROAD BRIDGES NOT TO BE OF STATUS LOWER THAN CLASS II.
 2. SHOULDERS ARE DELINEATED BY YELLOW PAINTED LINES AT CARRIAGEWAY EDGES.
 3. PARAPET HEIGHTS ON ROAD/RAIL BRIDGES IN ACCORDANCE WITH SATS 1983 BRIDGE CODE.
 4. CROSS SECTIONS TO TOP OF ASPHALT.
 5. FOR STRUCTURE NUMBERS REFER TO DWG. No. WCS/60/8/D1.



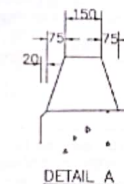
CYCLISTS / HIGH PEDESTRIAN TRAFFIC IW = 3,00
HIGH PEDESTRIAN TRAFFIC IW = 2,50
LOW PEDESTRIAN TRAFFIC IW = 2,00

DECK CROSS-SECTION OF
PEDESTRIAN UNDERPASS

ROAD CLASS	TRAFFIC COUNT EVU'S	CARRIAGEWAY WIDTH	STANDARD RURAL SINGLE CARRIAGEWAY BRIDGE WIDTHS									
			TYPE B1 AND R1					TYPE B2 AND R2				
			OVERALL (MIN)	SHOULDER	BETWEEN KERBS	SHOULDER	BETWEEN KERBS	FOOTWALK (MIN)	SHOULDER	BETWEEN KERBS	PEDESTRIAN REFUGE	FOOTWALK (MIN)
PROV. CLASS I	1000-2000	7,40	12,30	2,00	11,40	1,20	9,80	1,20	2,40	12,2	0,80	1,20
PROV. CLASS II	400-1000	8,80	10,70	1,50	9,80	0,90	8,60	1,20	1,80	10,40	0,80	1,20
PROV. CLASS III	< 400	6,50	9,50	0,90	8,60	0,50	8,00	1,20	1,20	9,20	0,80	1,20
PROV. CLASS IV SINGLE LANE (TYPE B1 & B2 ONLY)										4,00	0,80	

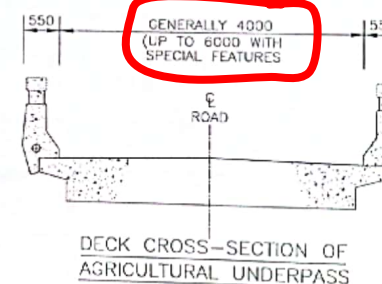


STANDARD RURAL DUAL DIVIDED CARRIAGEWAY BRIDGE WIDTHS

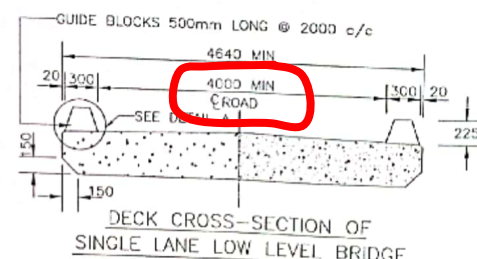


DETAIL A

- BRIDGE MEDIAN DECKED-IN WHEN:
1. B1 OR B2 < 22m; BRIDGE LENGTH < 6m or
 2. B1 OR B2 < 12m; BRIDGE LENGTH < 15m or
 3. B1 OR B2 < 6m; BRIDGE LENGTH < 30m or
 4. B1 OR B2 < 3m;

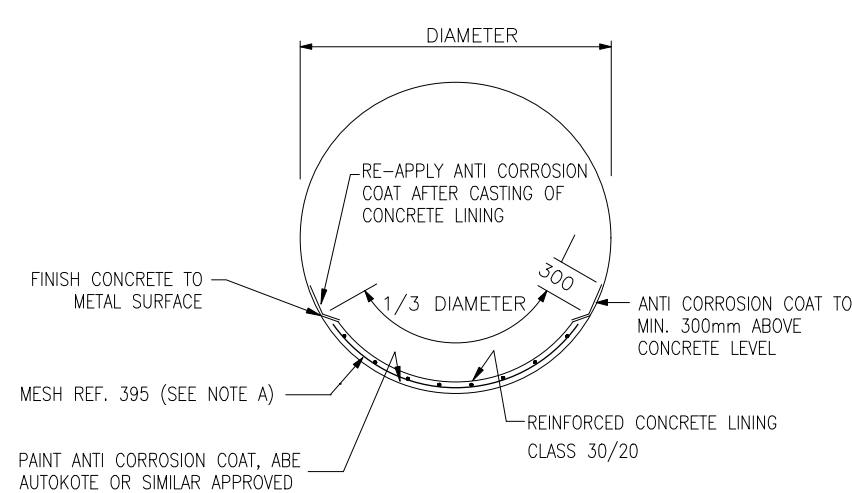


DECK CROSS-SECTION OF
AGRICULTURAL UNDERPASS



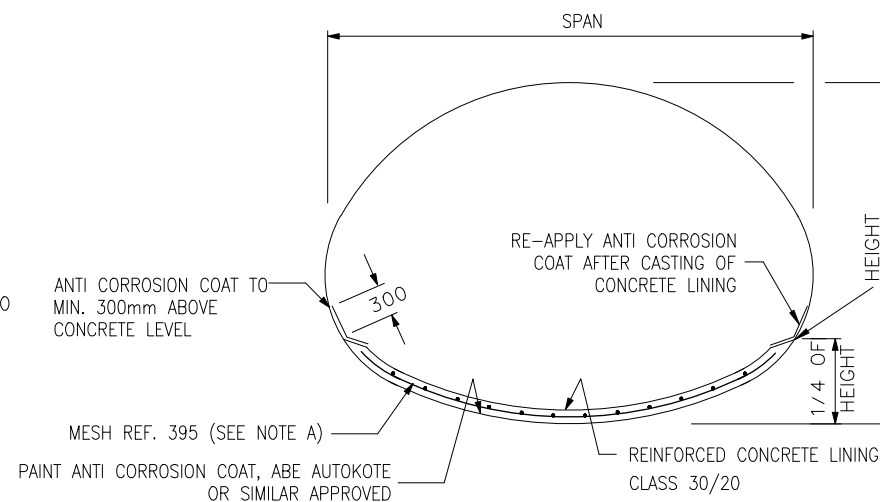
DECK CROSS-SECTION OF
SINGLE LANE LOW LEVEL BRIDGE

NO.	DATE	ADDITIONS AND AMENDMENTS	APPROVED	DATE	Issue Date:	2019	STANDARD PLANS	L.G.FOURIE CHIEF DIRECTOR ROAD NETWORK MANAGEMENT	BRIDGES	SCALE : N.T.S.	INDEX NO. WCS/60/1/D1
							WESTERN CAPE GOVERNMENT DEPARTMENT OF TRANSPORT AND PUBLIC WORKS		RURAL STRUCTURE STANDARD WIDTHS	A2 ORIGINAL	PLAN NO. SHEET 1 OF 2



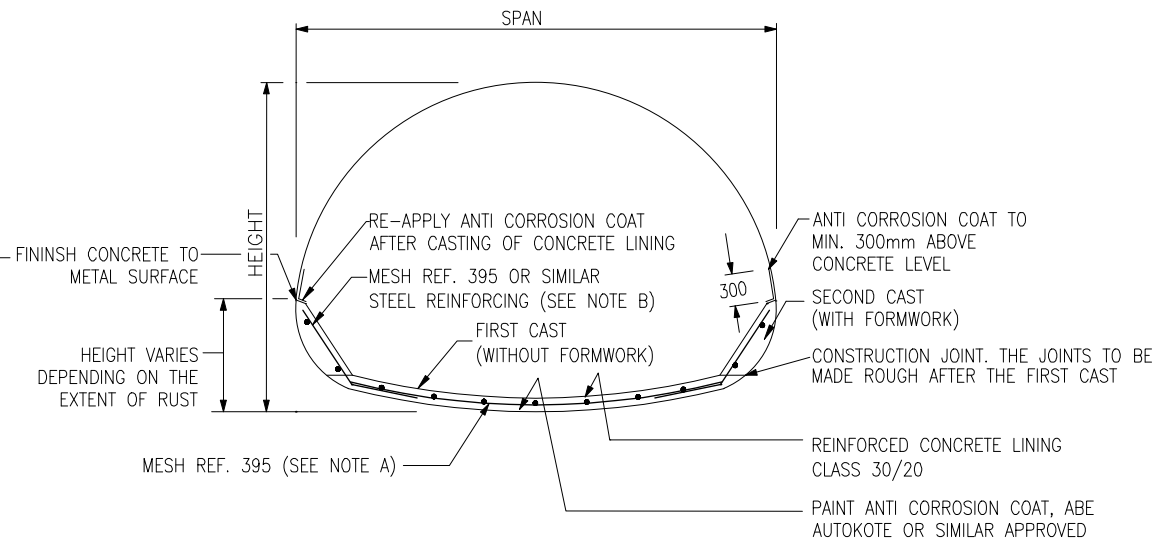
TYPICAL REINFORCED CONCRETE LINING FOR CIRCULAR ARMCO PIPE

FIGURE 1



TYPICAL REINFORCED CONCRETE LINING FOR OVAL ARMCO PIPE

FIGURE 2

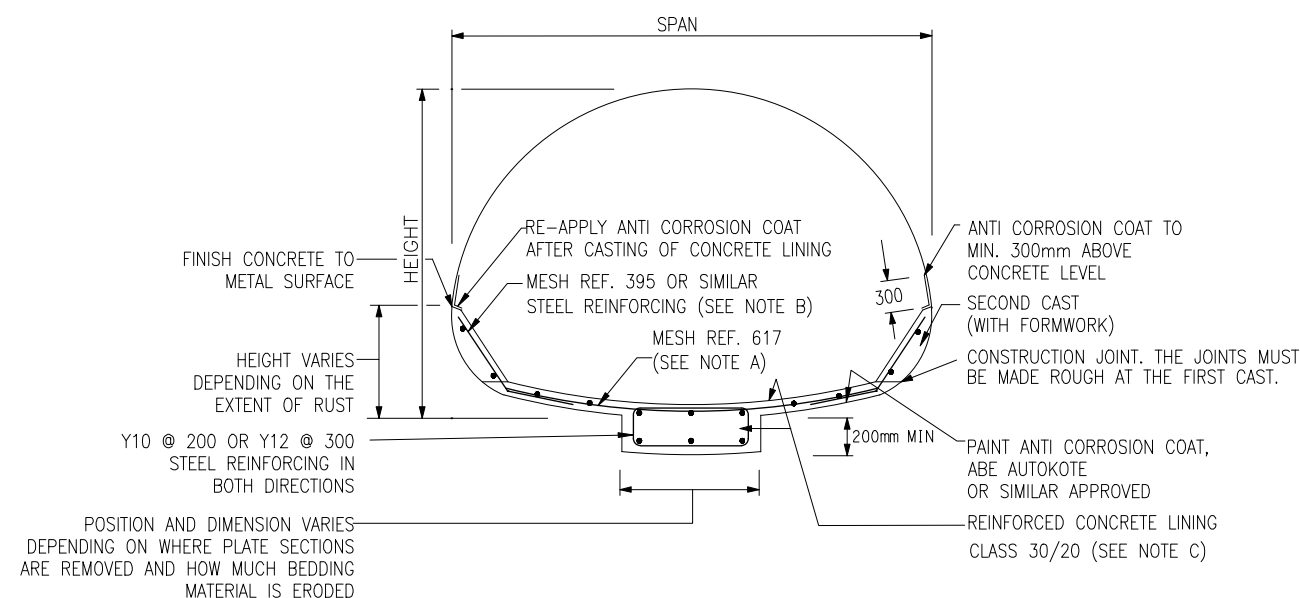


TYPICAL REINFORCED CONCRETE INVERT LINING FOR ARMCO PIPES WHERE RUST OCCURS HIGHER UP ON THE ARMCO WALLS OR WHERE THE ARMCO WALLS BECOME TOO STEEP FOR CASTING IN ONE STAGE.

FIGURE 3

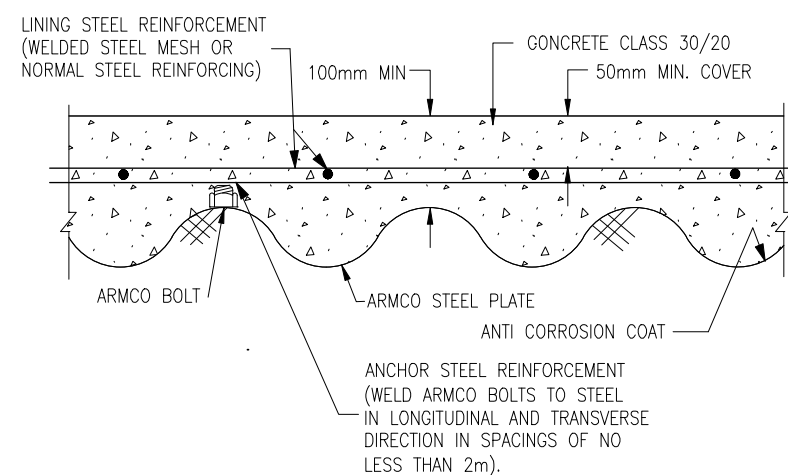
NOTES :

- THE STEEL MESH TO BE BENT ON SITE TO SUIT THE ARMCO DIMENSIONS. IN CASES WHERE THE STEEL MESH CANNOT BE BENT TO THE ARMCO DIMENSIONS, THEN NORMAL STEEL REINFORCEMENT BARS TO BE USED EQUIVALENT TO THAT OF THE PRESCRIBED STEEL MESH.
- THE REINFORCEMENT STEEL TO BE ANCHORED TO THE ARMCO BY MEANS OF WELDING ANCHOR STEEL TO THE EXISTING ARMCO BOLTS (SEE FIGURE 5). IN THE TRANSVERSE DIRECTION THE REINFORCEMENT MUST BE ANCHORED INTO THE FLOOR SECTION (FIRST CAST) BY 500mm MINIMUM.
- THE FLOOR SLAB TO BE CAST IN SECTIONS WHERE BEDDING MATERIAL IS REPLACED WITH CONCRETE (FIGURE 4).



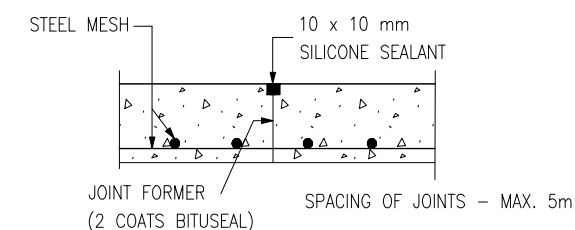
TYPICAL REINFORCED CONCRETE INVERT LINING FOR CASES WITH EXTREME CORROSION WHERE SECTIONS OF THE INVERT STEEL PLATE IS REMOVED AND BEDDING MATERIAL IS ERODED.

FIGURE 4



LONGITUDINAL SECTION THROUGH CONCRETE INVERT LINING

FIGURE 5



BUTT JOINT

FIGURE 6

No.	DATE	ADDITIONS AND AMENDMENTS	APPROVED	DATE	Issue Date:	STANDARD PLANS	L.G.FOURIE CHIEF DIRECTOR ROAD NETWORK MANAGEMENT	ARMCO CULVERT REPAIR METHODS	SCALE : N.T.S.	INDEX NO. WSC/60/9/D1
					2019	WESTERN CAPE GOVERNMENT DEPARTMENT OF TRANSPORT AND PUBLIC WORKS		CORRUGATED METAL CULVERT INVERT LINING	A2 ORIGINAL	PLAN NO. SHEET 1 OF 1

APPENDIX E: EXTRACT FROM TRH17: 1988 – GEOMETRIC DESIGN OF RURAL ROADS

TECHNICAL RECOMMENDATIONS
FOR HIGHWAYS

TRH17

**GEOMETRIC
DESIGN OF
RURAL ROADS**

1988

ISBN 0 7988 3312 2

TRH17, Pretoria, South Africa, 1988

5. CROSS-SECTIONAL ELEMENTS

5.1 Introduction

The cross-section of a road provides accommodation for moving and parked vehicles, drainage, public utilities and, to a lesser extent in the rural areas, pedestrians. For the safety and convenience of drivers, wide lanes and shoulders and gently sloping border areas are desirable, since they forgive minor errors of judgment and promote ease of operation.

Cross-sectional dimensions are discussed in the following sections. Alternatives to the dimensions suggested may be appropriate for particular conditions. Variations should be selected to suit these conditions, and careful consideration should be given to the function of the cross-sectional element before any departure from the recommended values.

5.2 Lanes

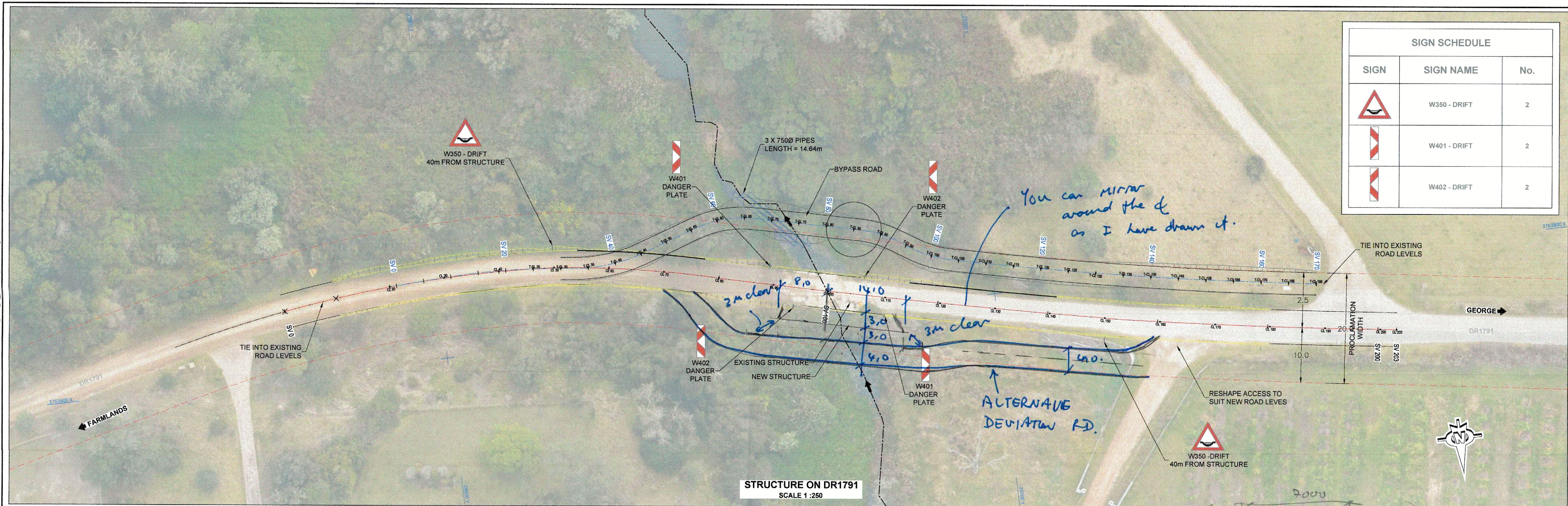
Undivided roads may have either one lane in each direction (two-lane two-way roads) or more than one lane in each direction (multi-lane roads). Dual carriage-way roads have two or more lanes in each direction and are described in terms of the total number of lanes, e.g. as four-lane divided or six-lane divided roads.

Customarily, there is symmetry of through lanes, and asymmetry on a particular section of road should arise only from the addition of an auxiliary lane that is clearly allocated to one direction of travel. Three-lane two-way roads have been built that were intended to function as two-lane two-way roads with a continuous central passing lane. These roads were found to have twice the capacity of two-lane two-way roads, but they have been abandoned, in spite of the saving in construction costs resulting from the narrower cross-section, because the practical effect of the three-lane cross-section is to concentrate the faster vehicles of the two opposing traffic streams in a common lane. This is similar to the situation found in the overtaking manoeuvre on a two-lane road, but in the latter case it is clear which of two opposing vehicles has the right of way. When three-lane roads are only marked as having three lanes with no passing restrictions, there is no clarity regarding right of way, and it is this lack of clarity that causes three-lane roads to be unsafe.

The selection of lane width is based on traffic volume and vehicle type and speed. Higher volumes and speeds require wider lanes, and the greatest lane width recommended is 3,7m. The narrowest width recommended is 3,1m, giving a clear space of 0,3 m on either side of a vehicle that is 2,5 m wide. This lane width will normally be employed only where speeds or traffic volumes are expected to be low. Intermediate conditions of volume and speed can be adequately catered for by a lane width of 3,4 m.

Where traffic volumes are such that a multi-lane cross-section or a divided cross-section is required, 3,7 m is a logical lane width to adopt. Lesser lane widths may however be warranted by abnormal circumstances.



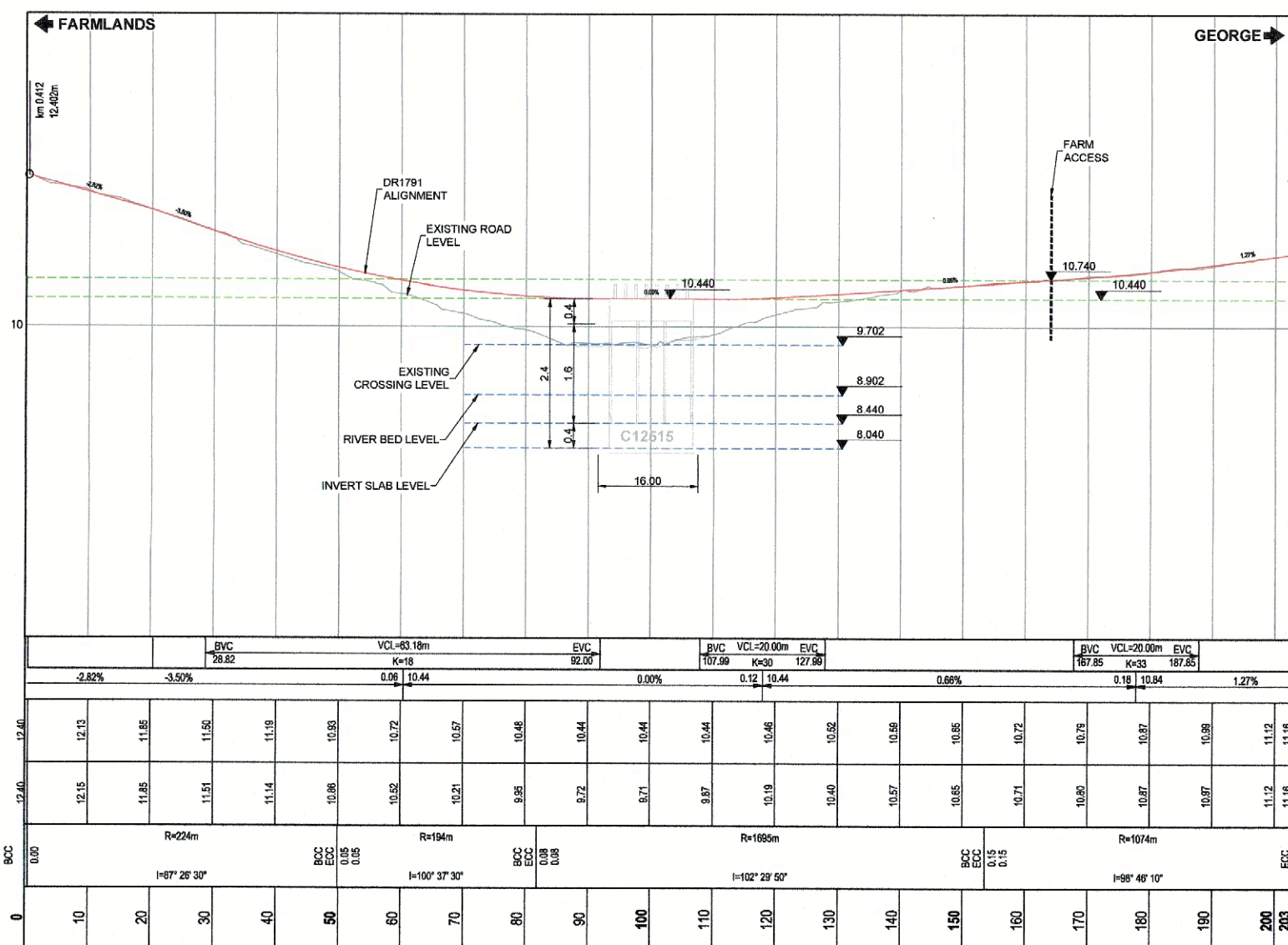
POINT TABLE - DR1791
CENTRE LINE - EXISTING ROAD

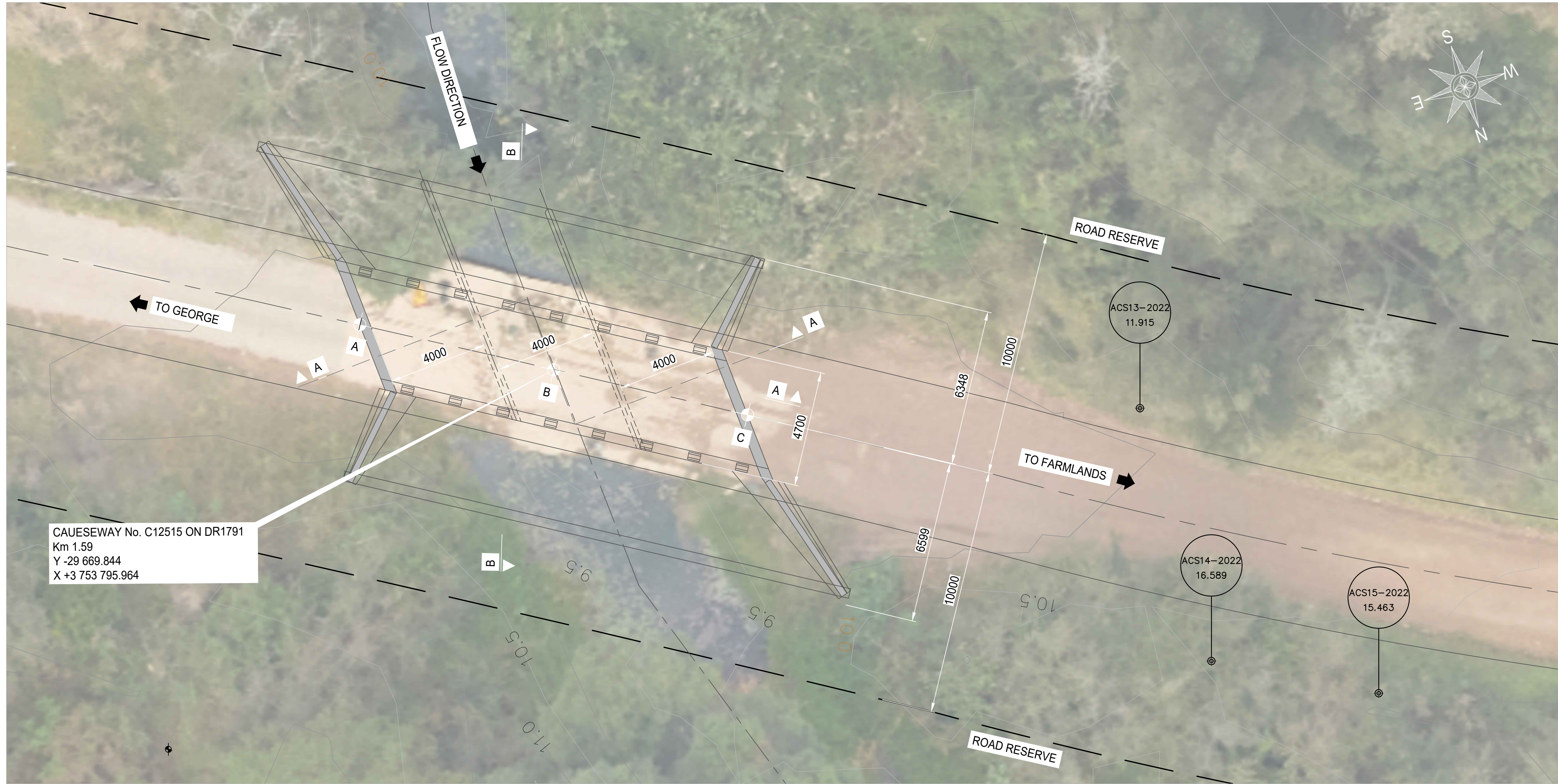
POINT	X	Y	LEVEL
CL 20	3 763 785.901	29 591.156	11.850
CL 30	3 763 785.498	29 601.145	11.503
CL 40	3 763 785.490	29 611.144	11.188
CL 50	3 763 785.932	29 621.133	10.928
CL 60	3 763 787.222	29 631.049	10.723
CL 70	3 763 788.022	29 640.884	10.574
CL 80	3 763 791.326	29 650.614	10.480
CL 90	3 763 793.720	29 660.323	10.441
CL 100	3 763 796.014	29 670.056	10.440
CL 110	3 763 798.342	29 680.204	10.441
CL 120	3 763 800.519	29 689.884	10.466
CL 130	3 763 802.638	29 698.737	10.522
CL 140	3 763 804.699	29 708.522	10.589
CL 150	3 763 806.703	29 719.319	10.655
CL 160	3 763 808.502	29 729.156	10.721
CL 170	3 763 810.146	29 739.019	10.789
CL 180	3 763 811.999	29 748.898	10.879
CL 190	3 763 813.159	29 758.791	10.997
CL 200	3 763 814.527	29 768.697	11.124
CL 203	3 763 814.909	29 771.818	11.161

SCALES
HOR 1 : 500
VERT 1 : 50

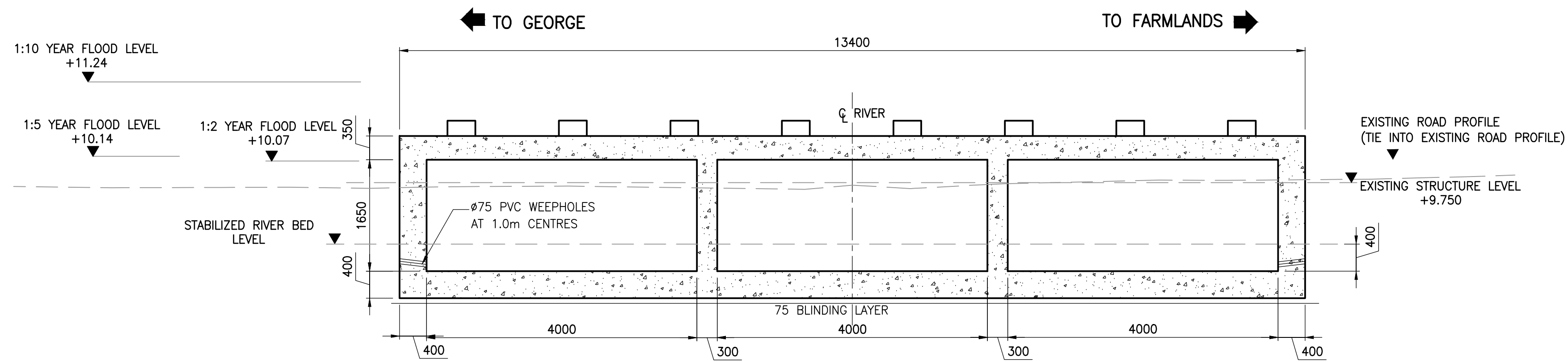
DATUM 5.000

VERTICAL PROFILE GRADES
CENTRE LINE (CL)
GROUND LEVELS ON CL
HORIZONTAL ALIGNMENT
DISTANCE (m)

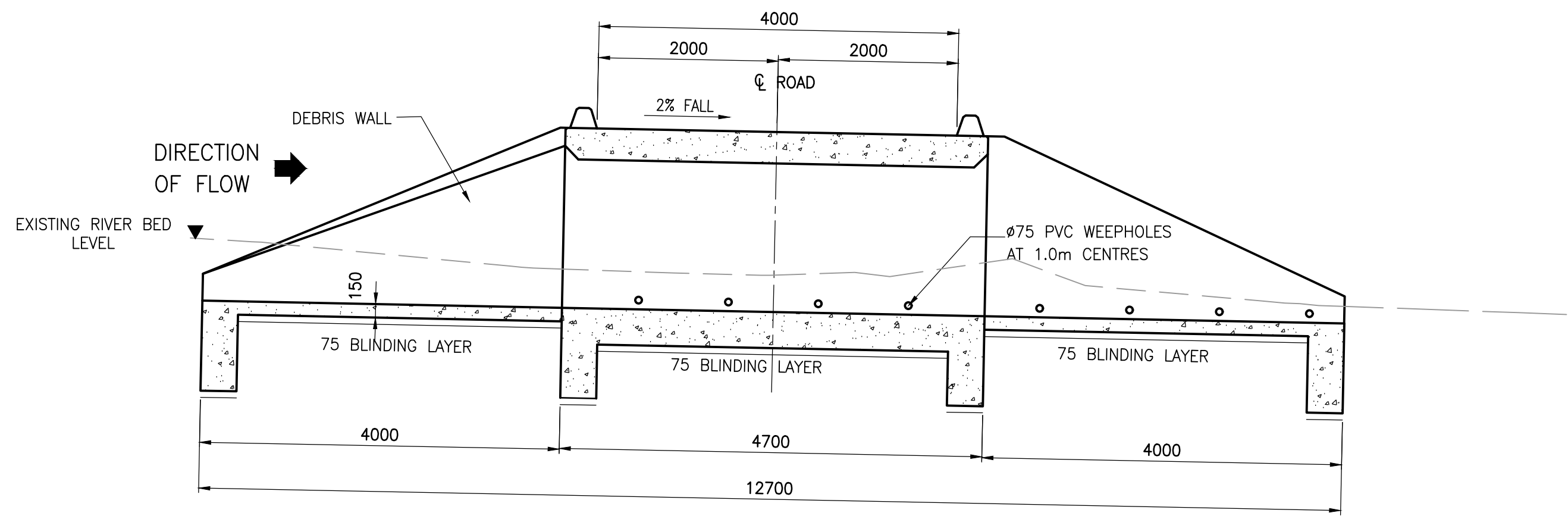




PLAN ON CAUSEWAY
SCALE 1:100



ROAD CROSS SECTION A-A
SCALE 1:50



RIVER CROSS SECTION B-B
SCALE 1:50



KEY PLAN
SCALE N.T.S

CO-ORDINATES WGS84			
POINT	Y	X	
A	-29 677.957	+3 763 797.832	
B	-29 670.056	+3 763 796.014	
C	+4 307298.4	+3 763 794.151	

BENCHMARK COORDINATES			
POINT	Y	X	LEVEL
ACS13-2022	-29 828.18	+3 763 816.207	11.915
ACS14-2022	-29 959.21	+3 763 855.534	16.589
ACS15-2022	-30 068.099	+3 763 900.662	15.463

GENERAL NOTES

- GENERAL
 - THE SETTING OUT OF THE STRUCTURE TO BE AS PER CO-ORDINATES.
 - ALL WORK TO BE EXECUTED AS PER COLTO STANDARDS
- DESIGN LOADING
 - NA AND NB36 TO TMH7 AND CONFORMS TO STANDARD DRAWINGS OF THE WESTERN CAPE GOVERNMENT.
- CHARACTERISTIC STRENGTH OF MATERIALS
 - CONCRETE:

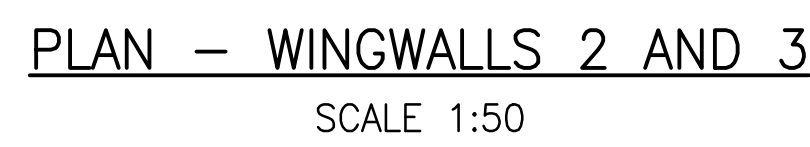
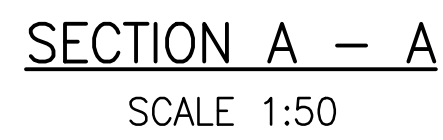
ELEMENT	CHARACTERISTIC STRENGTH (MPa)	CONCRETE CLASS
BLINDING	15	15MPa/20mm
MASS CONCRETE	15	15MPa/20mm
REINF. CONCRETE	30	30MPa/20mm
GABION TOPPING	30	30MPa/14mm
GROUTED PLUMS	30	30MPa/20mm
- STRUCTURE
 - ALL EXPOSED CORNERS HAVE 20X20 CHAMFERS
 - COVER TO REBAR 50mm
 - CONCRETE FINISHES:
- EARTHWORKS
 - MINIMUM BEARING CAPACITY OF FOUNDATION TO BE 150kPa. FOUNDATIONS TO BE INSPECTED BY ENGINEER BEFORE BLINDING CONCRETE IS POURED.
- HYDRAULICS
 - THE OPENING IS SIZED TO ALLOW THE 1 IN 2 YEAR FLOOD REPORT THROUGH WITH ZERO FREEBOARD.
 - CATCHMENT AREA: 20.707km²
 - HYDROLOGICAL METHOD OF FLOOD ANALYSIS: RATIONAL ALT 3
 - MEAN SLOPE OF RIVER BED: 0,04m/m
 - DATA

3.2 REINFORCEMENT	
DESCRIPTION	CHARACTERISTIC STRENGTH (MPa)
MILD STEEL	250
HIGH TENSILE STEEL	450
WELDED MESH TO SANS 1024	485

MEAN RETURN PERIOD	FLOOD VOLUME (m ³ /s)	FLOOD VELOCITY (m/s)	FROUDE NUMBER	FLOOD HEIGHT RELATIVE TO TOP OF DECK
1:2 YEAR	13.44	1.34	0.55	-0.37
1:5 YEAR	21.75	1.66	0.63	-0.30
1:10 YEAR	29.20	1.95	0.90	0.80

NO.	DATE	ADDITIONS, AMENDMENTS AND REVISIONS	PROVINCIAL CHIEF ENG.	CONSULT. ENG.	DESIGNED BY:	DETAILED BY:	CONSULTANT'S APPROVAL		ACCEPTANCE		P.R.E.'s FILE NO.		SCALE	AS SHOWN	ORIGINAL PAPER SIZE
VB	04/2025	FOR TENDER	M.PETERSEN	D. MALAN	A. HEARNE	B. MEYER	SIGN:	NAME: DAWIE MALAN	THIS APPROVAL IS FOR PROCEDURAL AND ADMINISTRATIVE REVIEW PURPOSES ONLY AND DOES NOT ATTRACT LEGAL LIABILITY OF ANY KIND FROM WHATSOEVER OR HOWEVER ARISING	PROVINCIAL ROADS ENGINEER	DOI16/6/4/1/4/C1157.02		SHEETS	OF	A0
					CHECKED BY: D. MALAN	CHECKED BY: A. HEARNE	NAME: DAWIE MALAN	ECDA PIN NO: 940057			CONTRACT NO. C1157.02		WCG STRUCTURE PLAN C12515/01		
											CONSULTANTS DWG NO. H36196-00000-220-270-1791-0001		WCG INDEX NO. A99131		VER VB

NO.	DATE	ADDITIONS, AMENDMENTS AND REVISIONS	PROVINCIAL CHIEF ENG.	CONSULT. ENG.	DESIGNED BY:	DETAILED BY:	CONSULTANT'S APPROVAL		 Western Cape Government Infrastructure	ACCEPTANCE	CAUSEWAY No 12515 on DR1791 at Km 1.59 over BITOU RIVER NEAR STOPPAD	P.R.E.'S FILE NO.	SCALE	ORIGINAL PAPER SIZE	
VB	04/2025	FOR TENDER	M.PETERSEN	D. MALAN	J. SADIE	J. SADIE		SIGN: _____		THIS APPROVAL IS FOR PROCEDURAL AND ADMINISTRATIVE REVIEW PURPOSES ONLY AND DOES NOT ATTRACT LEGAL LIABILITY OF ANY KIND FROM WHATSOEVER OR HOWEVER ARISING		CONTRACT NO.	C1157.02	WCG STANDARD PLAN	SHEETS OF
					CHECKED BY:	CHECKED BY:	False Bay Building Tygerberg Park 163 Uys Krige Drive Platteklouf, 7500	*27 21 9115823 www.hatch.com		PROVINCIAL ROADS ENGINEER		CONSULTANTS DWG NO.	WCG INDEX NO.	VER	
					A. HEARNE	D. MALAN				DATE: _____		H361596-00000-223-272-1791-0001	A99/132	VB	
											LONGITUDINAL SECTIONS				



NOTES

- 1 ALL VISIBLE CORNERS TO HAVE 20X20mm CHAMFERS
- 2 CONCRETE FINISHES
- | DESCRIPTION | FINISH |
|----------------------|--------|
| NON VISIBLE SURFACES | F1, U1 |
| VISIBLE SURFACES | F2, U2 |
- 3 CONCRETE STRENGTHS
- | ELEMENT | CHARACTERISTIC STRENGTH (MPa) | CONCRETE CLASS |
|-----------------|-------------------------------|----------------|
| BLINDING | 15 | 15MPa/20mm |
| MASS CONCRETE | 15 | 15MPa/20mm |
| REINF. CONCRETE | 30 | 30MPa/20mm |
| GABION TOPPING | 30 | 30MPa/20mm |
| GROUTED PLUMS | 30 | 30MPa/20mm |
- 4 PROVIDE 75mm BLINDING LAYER UNDER ALL POURED ON THE GROUND
- 5 UNFILLED JOINTS (BUTT JOINTS) TO BE PAINTED WITH A BOND BREAKER BEFORE CASTING ADJACENT POUR



NO.	DATE	ADDITIONS, AMENDMENTS AND REVISIONS	PROVINCIAL CHIEF ENG.	CONSULT. ENG.	DESIGNED BY:	DETAILED BY:
VB	04/2025	FOR TENDER	M PETERSEN	D. MALAN	A. HEARNE	B. MEYER
					CHECKED BY:	CHECKED BY:
					D. MALAN	A. HEARNE

HATCH

False Bay Building
Tygerberg Park
163 Uys Krige Drive
Platteklouf, 7500

*27 21 9115823
www.hatch.com

CONSULTANT'S APPROVAL

SIGN: 

NAME: **DAWIE MALAN**

ECSA Pr No. **940057**

DATE: **APRIL 2025**



**Western Cape
Government**

FOR YOU

Infrastructure

ACCEPTANCE

**THIS APPROVAL IS FOR PROCEDURAL AND
ADMINISTRATIVE REVIEW PURPOSES
ONLY AND DOES NOT ATTRACT LEGAL
LIABILITY OF ANY KIND FROM
WHATSOEVER OR HOWEVER ARISING**

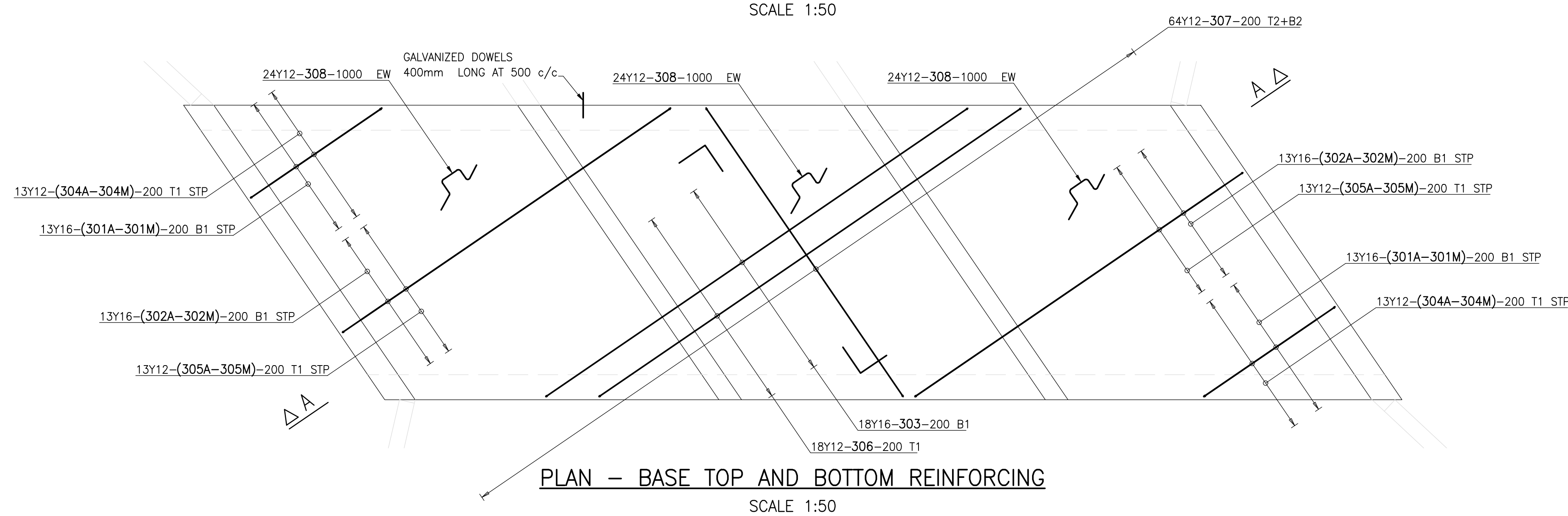
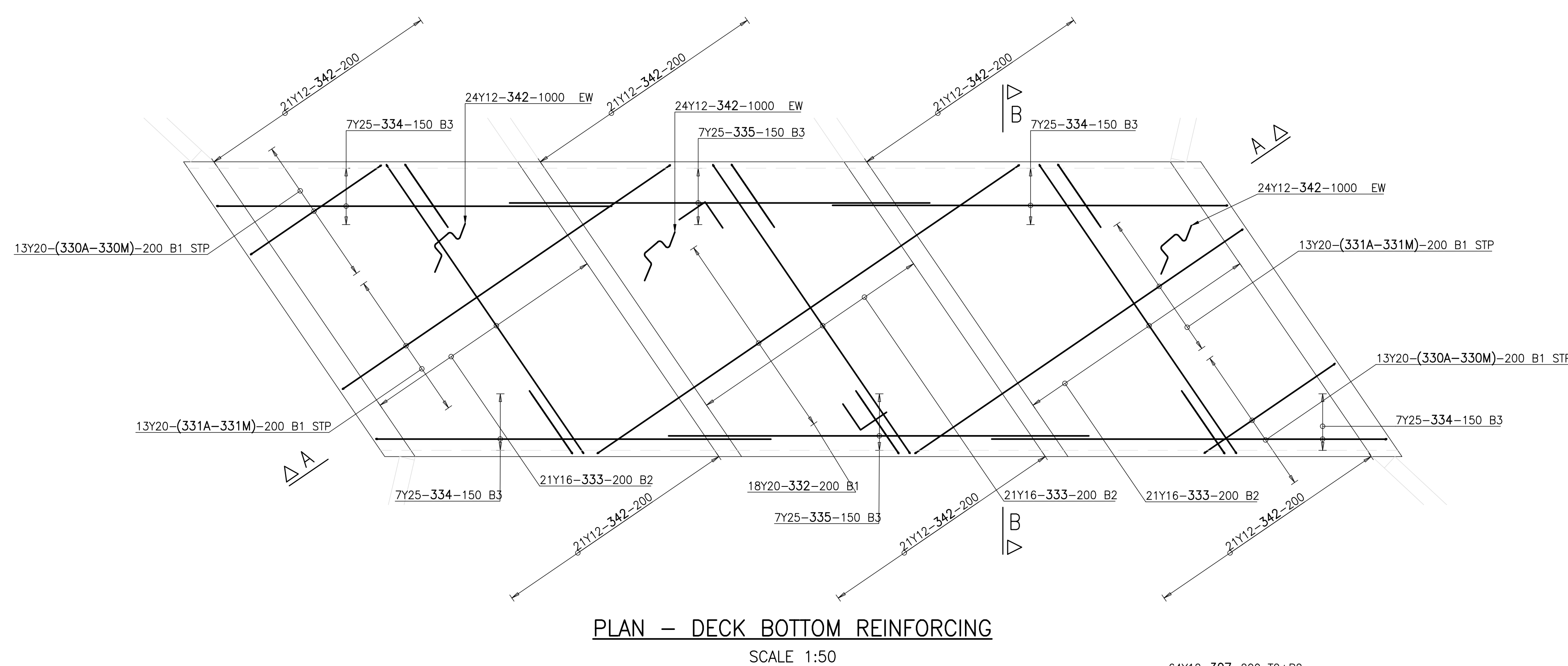
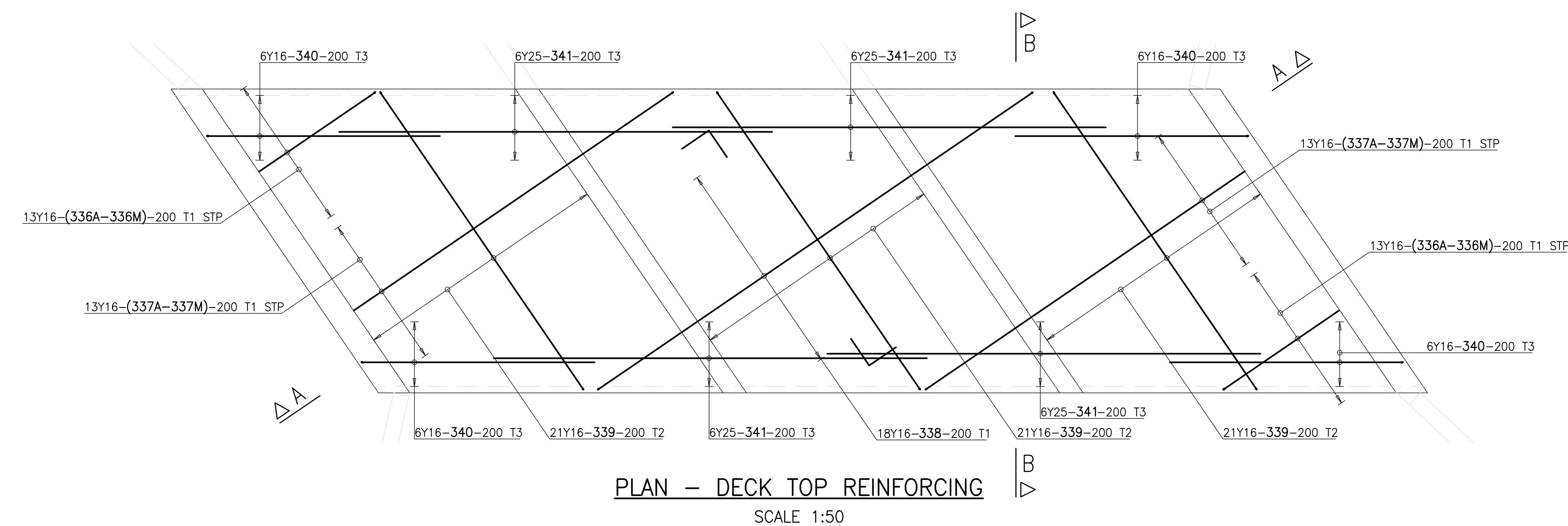
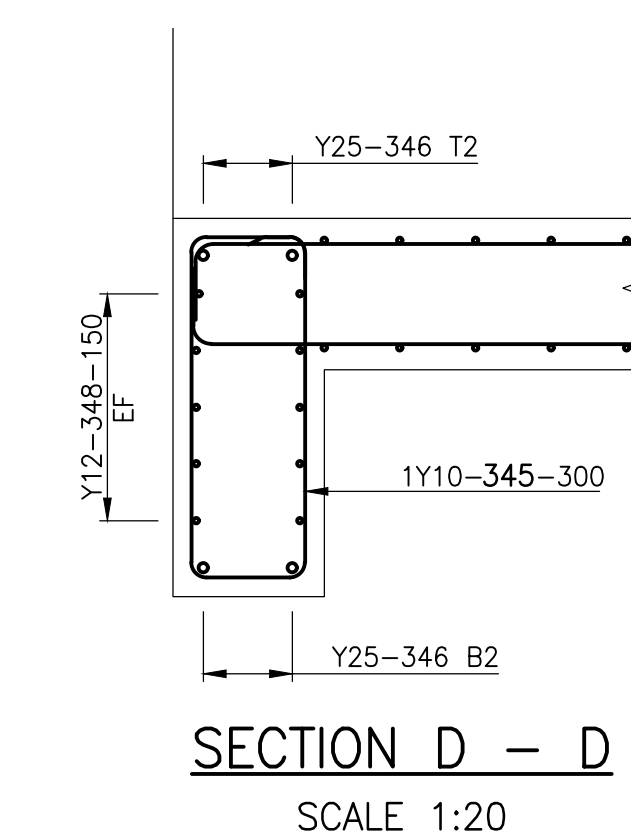
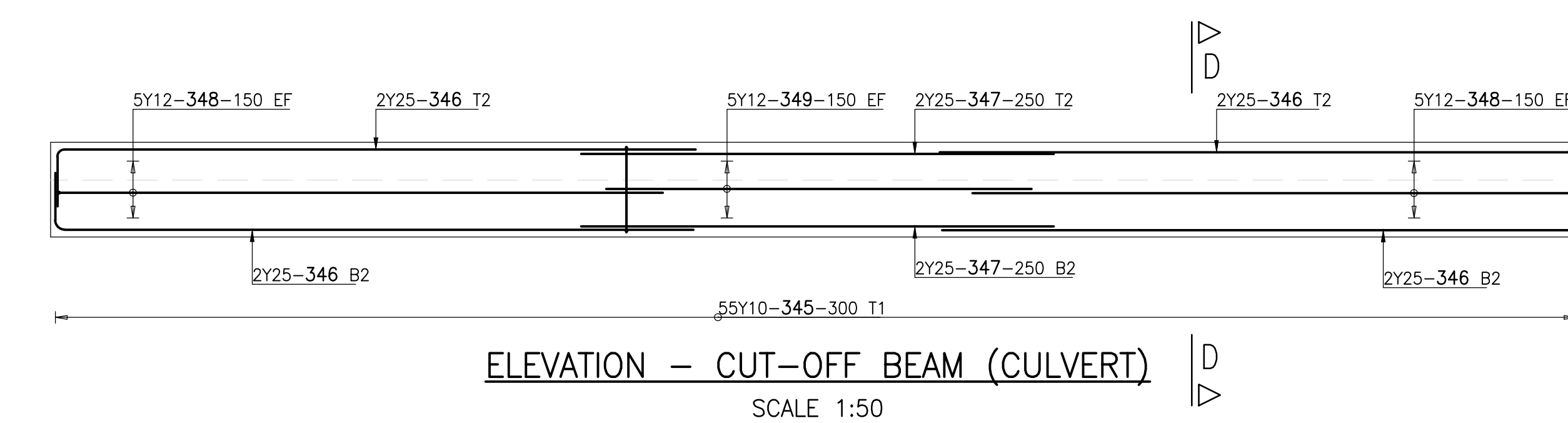
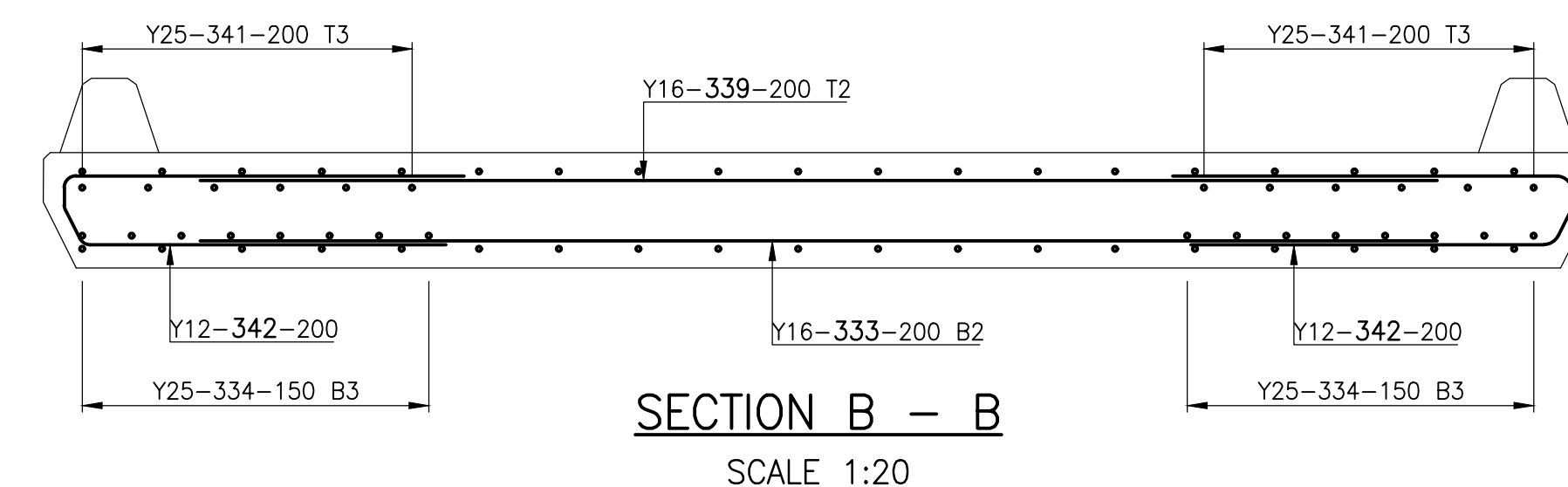
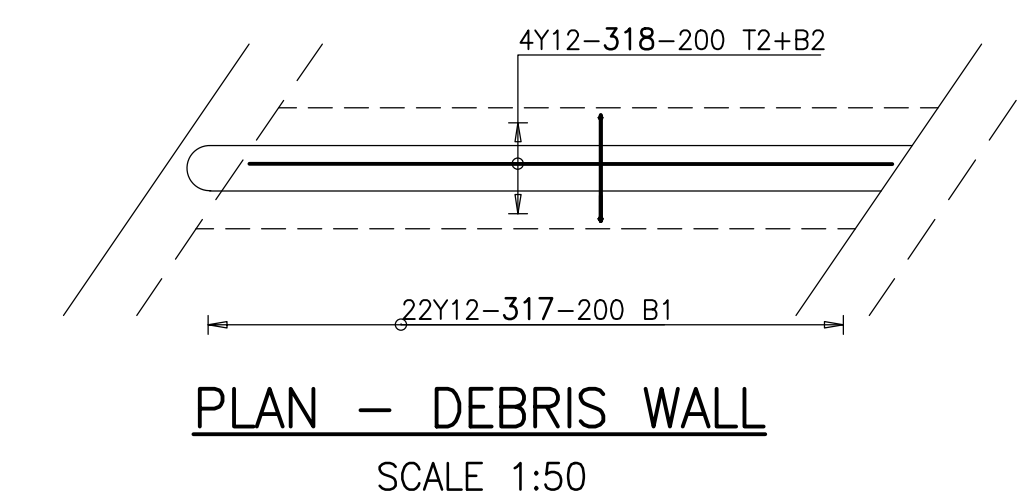
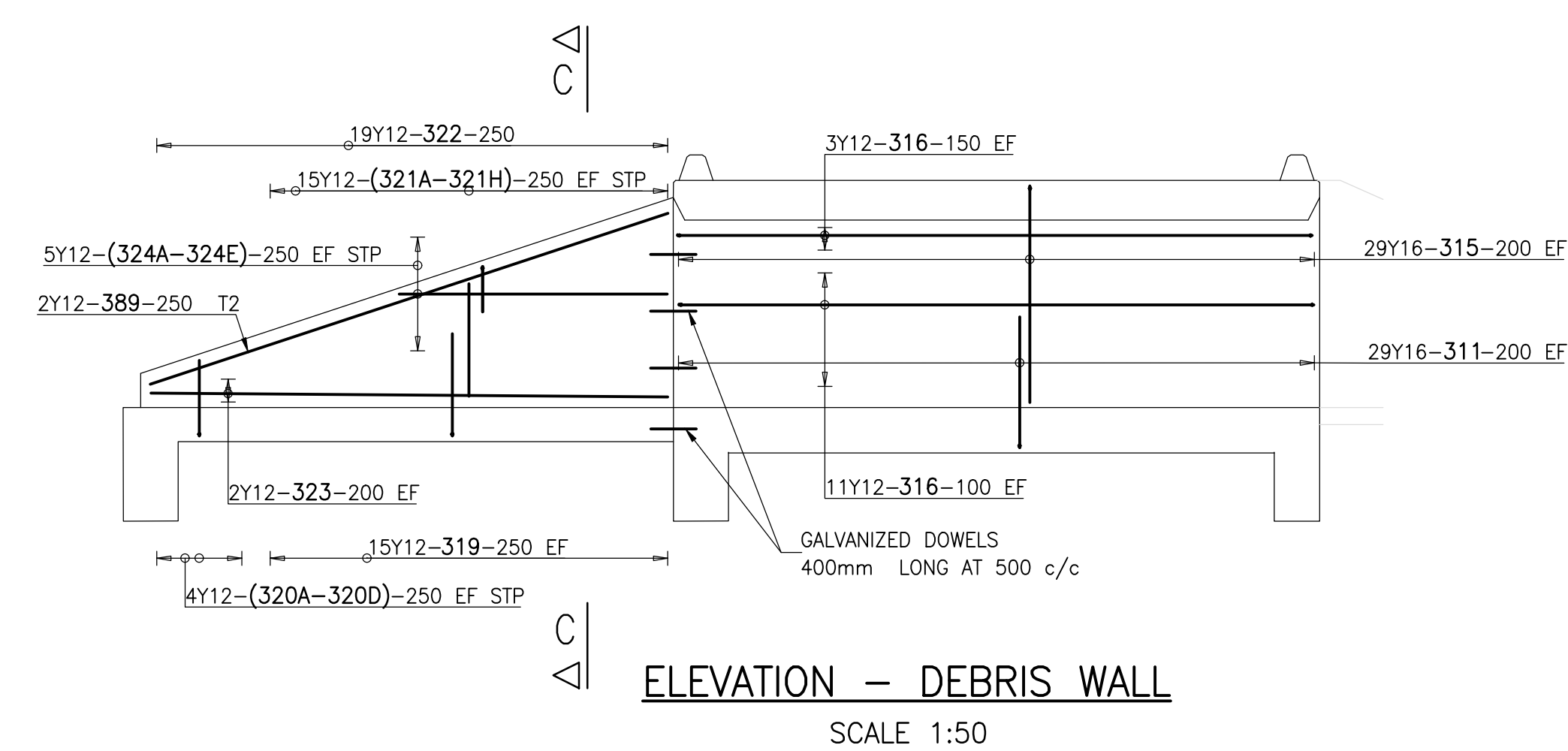
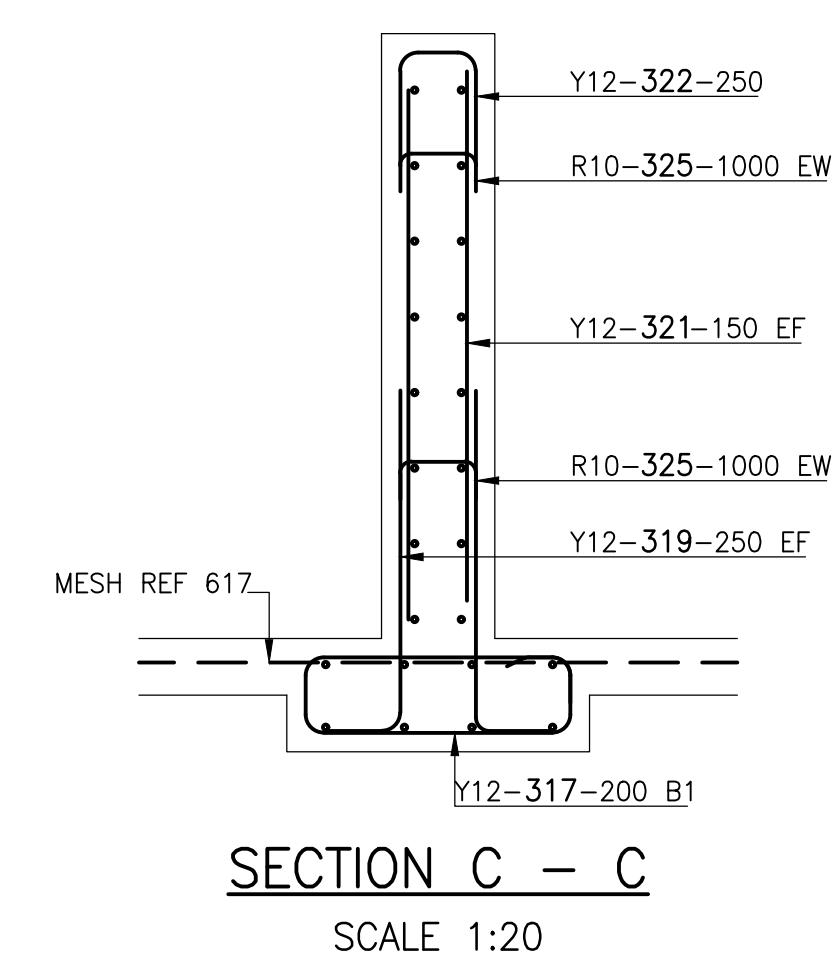
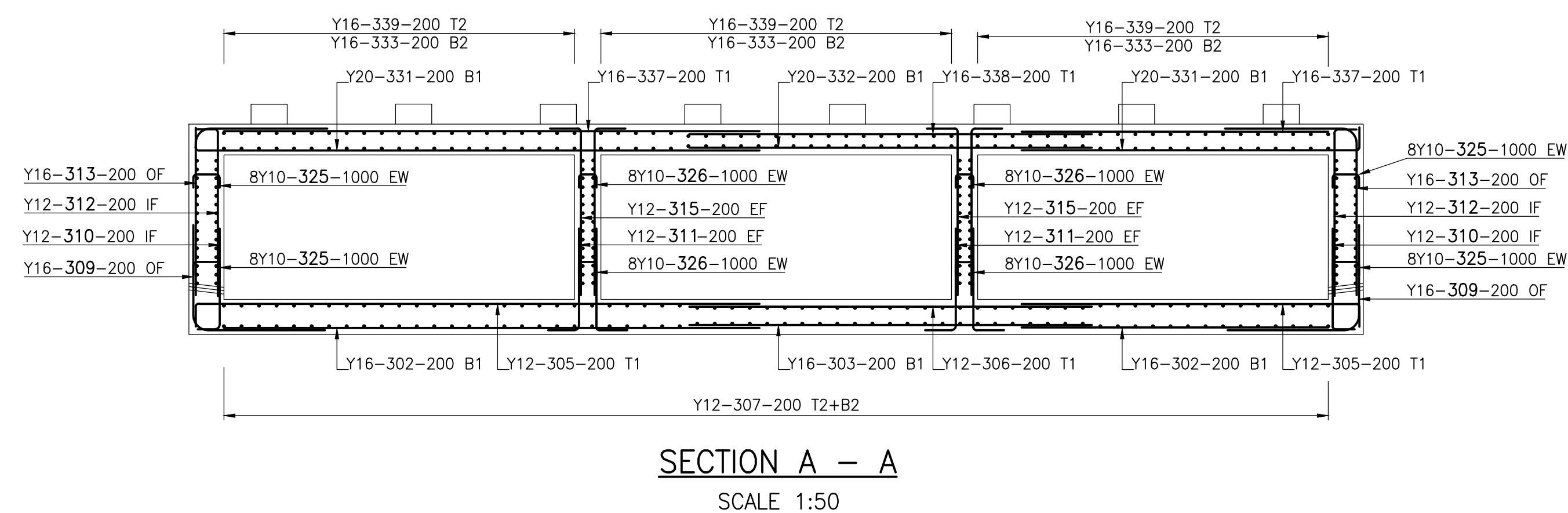
PROVINCIAL ROADS ENGINEER

DATE: _____

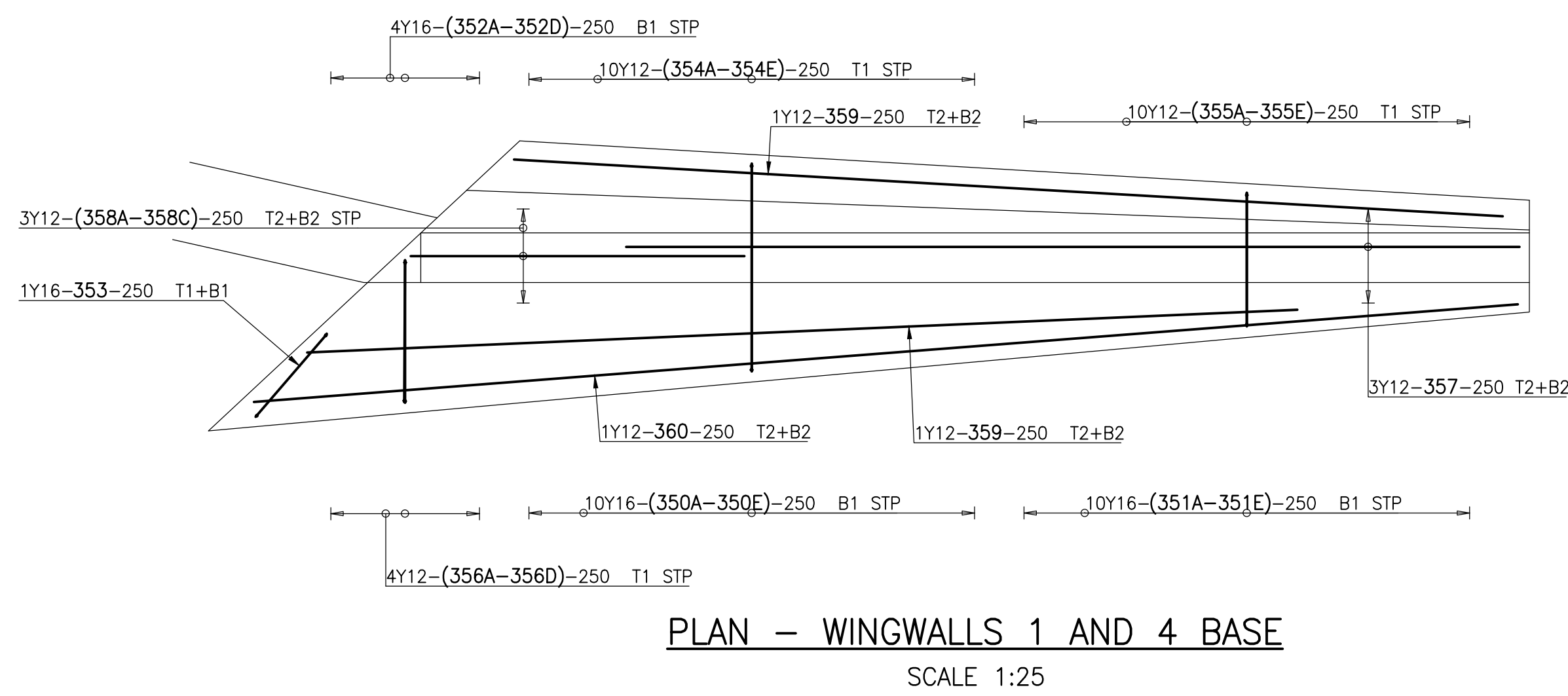
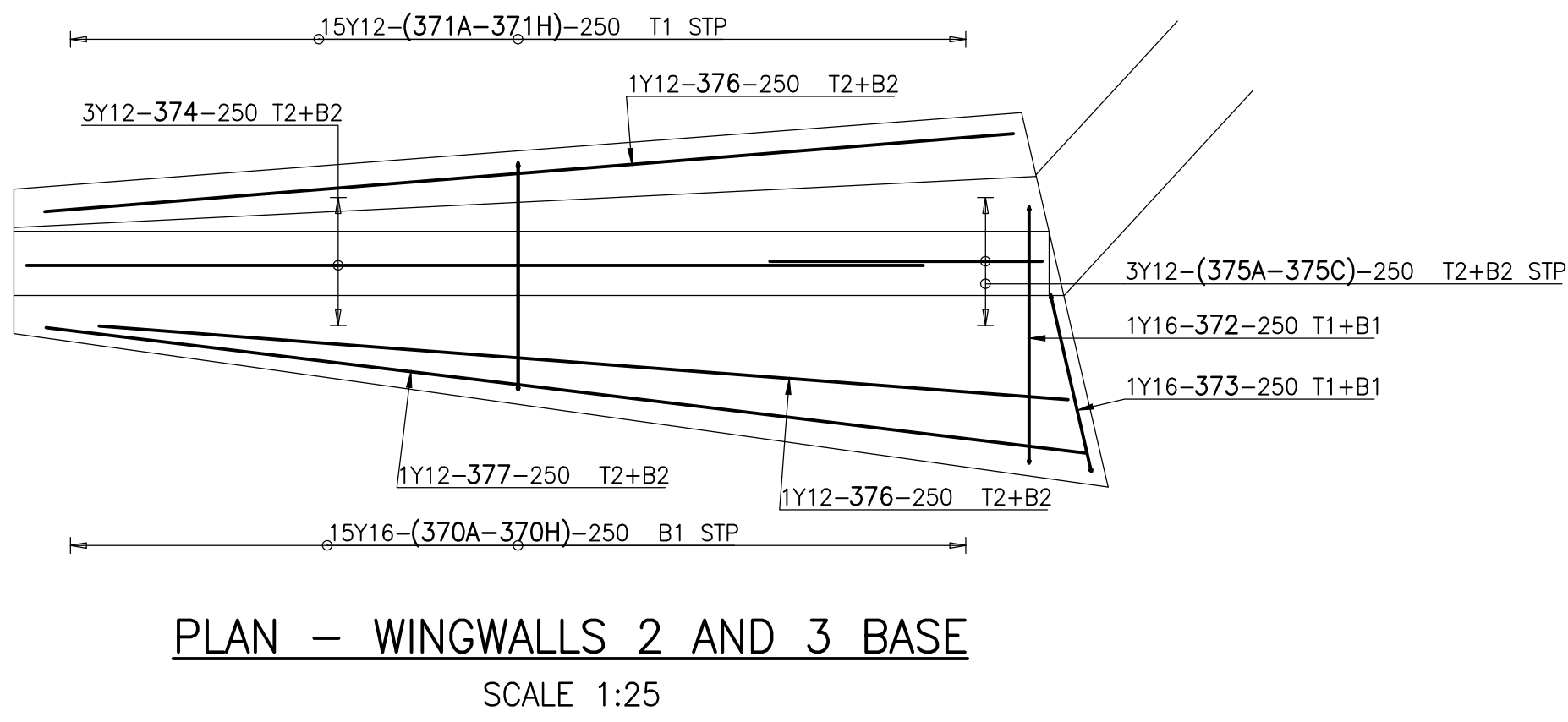
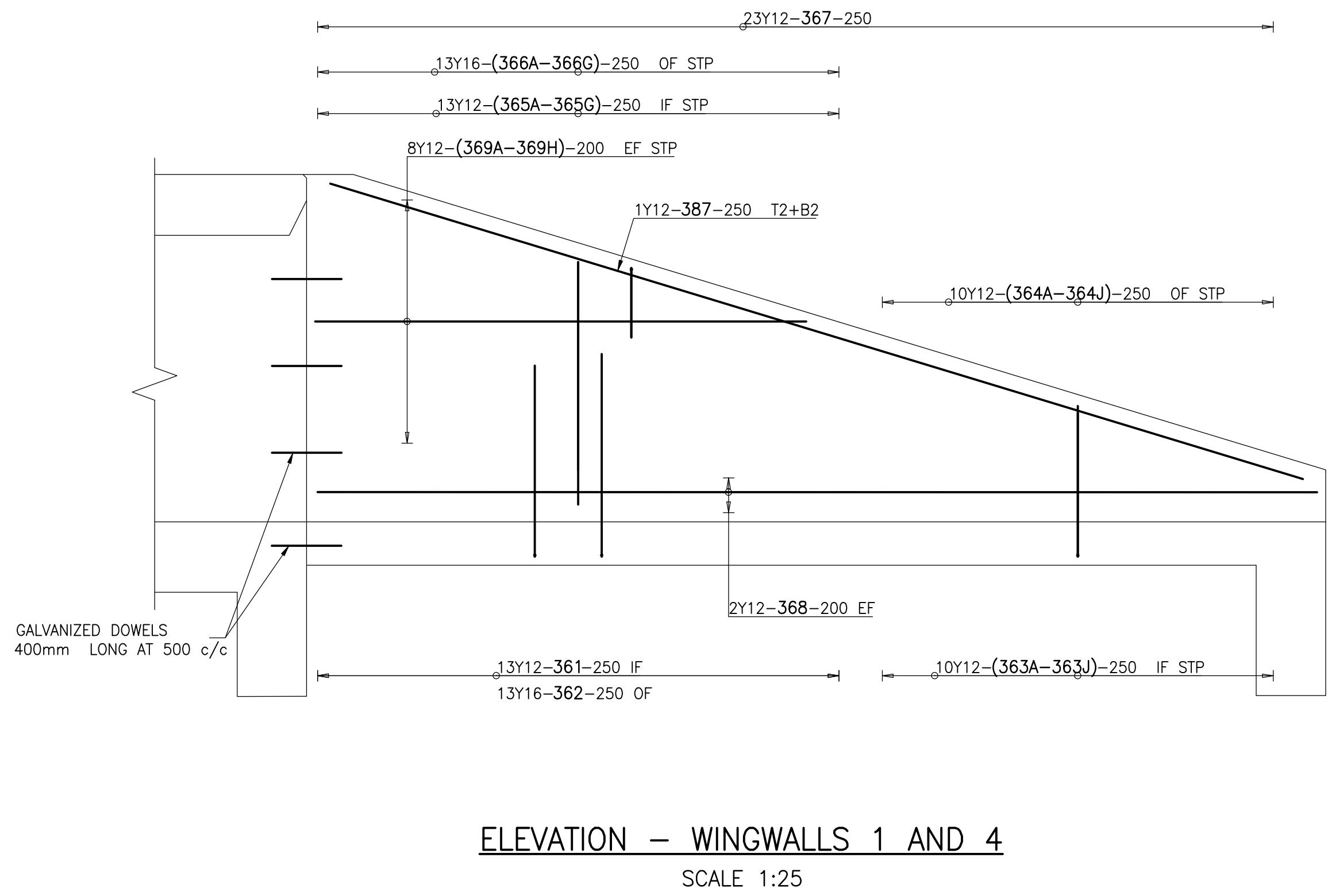
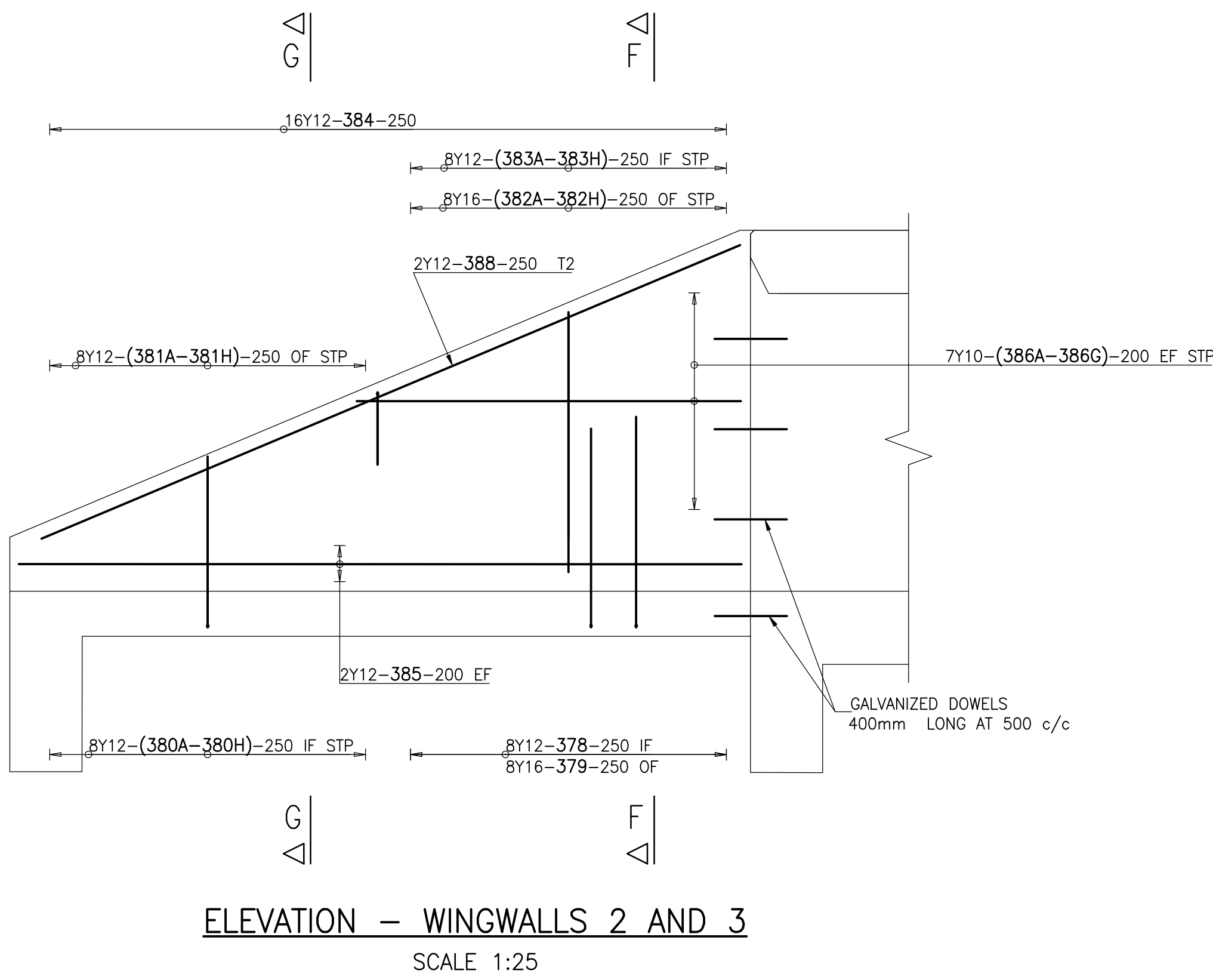
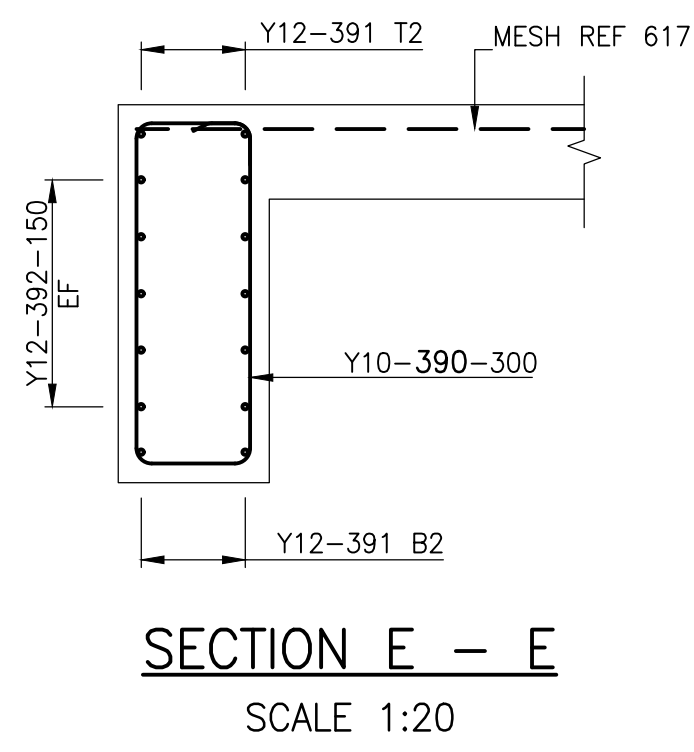
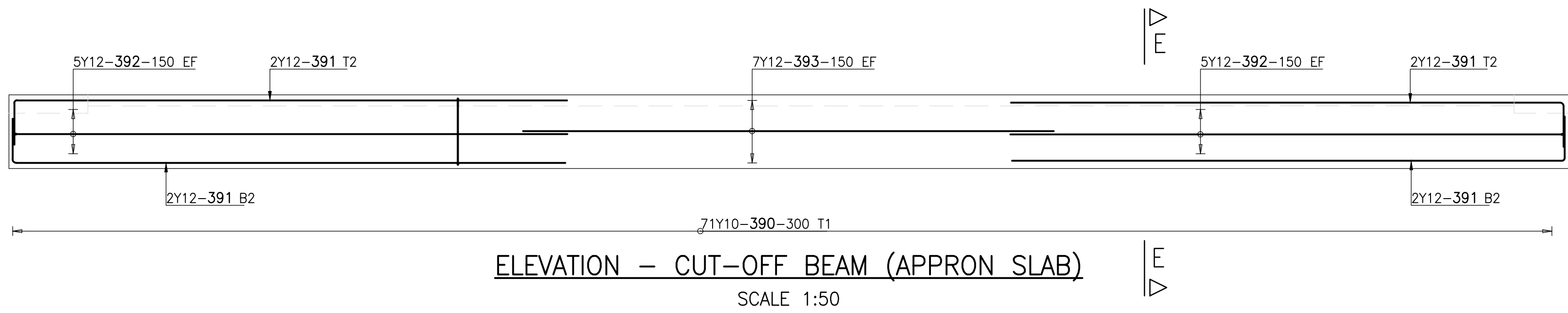
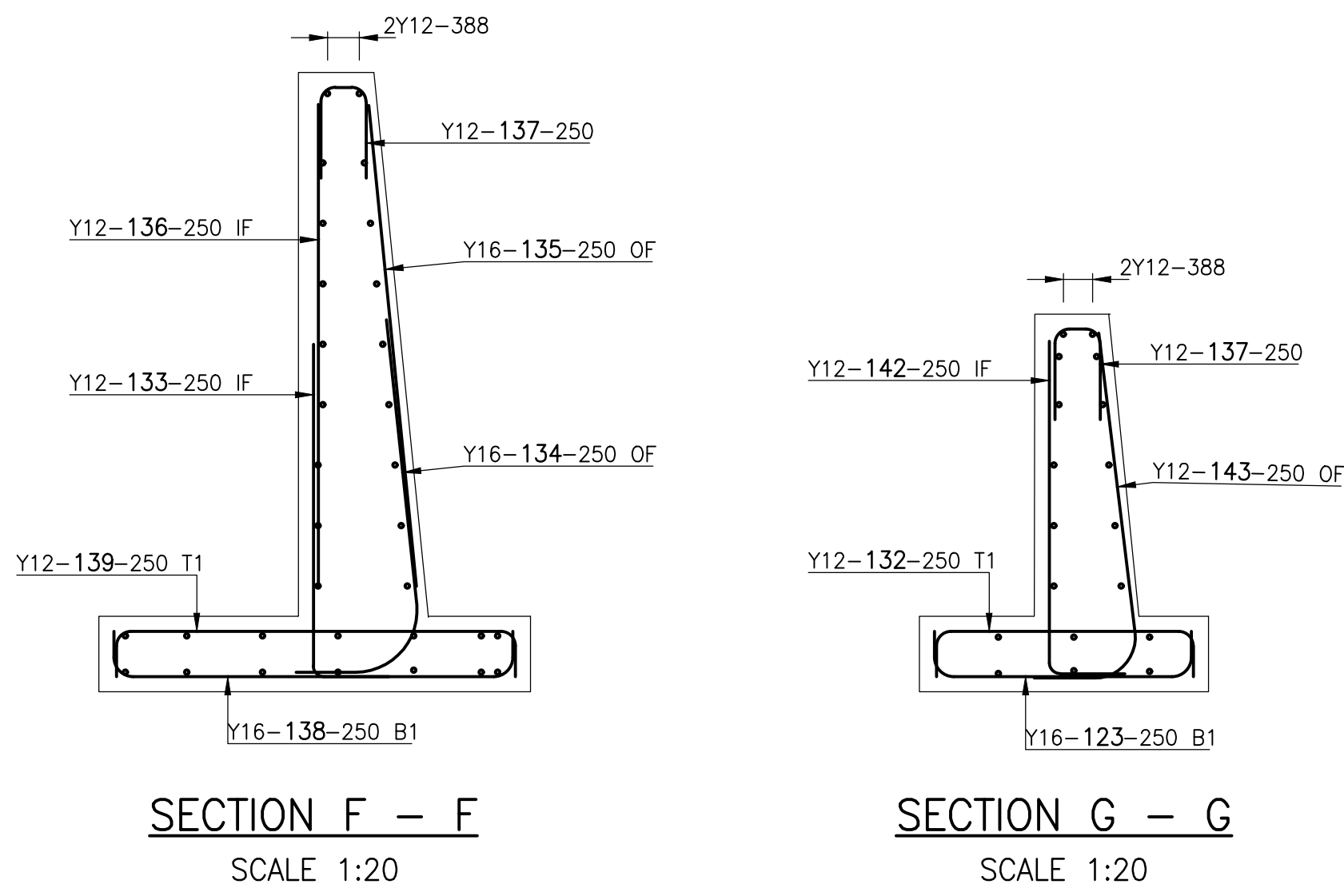
CAUSEWAY No 12515 on DR1791 at Km 1.59 over BITOU RIVER NEAR STOPPAD

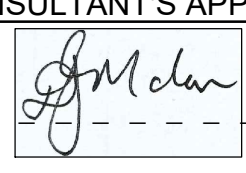
CONCRETE DETAILS

P.R.E.'s FILE NO. DOI16/6/14/14/C1157.02	SCALE AS SHOWN SHEETS OF	ORIGINAL PAPER SIZE A0
CONTRACT NO. C1157.02	WCG STRUCTURE PLAN C125/03	
CONSULTANTS DWG NO. H361596-00000-231-272-1791-0001	WCG INDEX NO. A99/133	VER VB



NO.	DATE	ADDITIONS, AMENDMENTS AND REVISIONS	PROVINCIAL CHIEF ENG.	CONSULT. ENG.	DESIGNED BY:	DETAILED BY:	CONSULTANT'S APPROVAL		 Western Cape Government Infrastructure FOR YOU	ACCEPTANCE THIS APPROVAL IS FOR PROCEDURAL AND ADMINISTRATIVE REVIEW PURPOSES ONLY AND DOES NOT ATTRACT LEGAL LIABILITY OF ANY KIND FROM WHATSOEVER OR HOWEVER ARISING CONTRACT NO. C1157.02 PROVINCIAL ROADS ENGINEER DATE:	P.R.E.'S FILE NO. D016/6/4114/C1157.02 SCALE SHEETS OF A0
VB	04/2025	FOR TENDER	M PETERSEN	D. MALAN	A. HEARNE	B OLIVIER	SIGN:  NAME: DAWIE MALAN ECISA PI NO.: B40057 DATE: APRIL 2025	CAUSEWAY No 12515 on DR1791 at Km 1.59 over BITOU RIVER NEAR STOPPAD WCG STRUCTURE PLAN C12515/04		CONSULTANTS DWG NO. H361596-00000-238-272-1791-0001 A39/134	WCG INDEX NO. VER
					CHECKED BY: D. MALAN	CHECKED BY: A. HEARNE	False Bay Building Tygerberg Park 163 Uys Krige Drive Platteklouf, 7500 +27 21 9115823 www.hatch.com	REINFORCEMENT DETAILS CELLULAR STRUCTURE			



NO.			DATE		ADDITIONS, AMENDMENTS AND REVISIONS		PROVINCIAL CHIEF ENG.	CONSULT. ENG.	DESIGNED BY:	DETAILED BY:	HATCH		CONSULTANT'S APPROVAL		Western Cape Government		ACCEPTANCE		CAUSEWAY No 12515 on DR1791 at Km 1.59 over BITOU RIVER NEAR STOPPAD		P.R.E's FILE NO.		SCALE		ORIGINAL PAPER SIZE	
VB			04/2025		FOR TENDER		M PETERSEN	D. MALAN	A. HEARNE	B. OLIVIER			SIGN: 		Western Cape Government		THIS APPROVAL IS FOR PROCEDURAL AND ADMINISTRATIVE REVIEW PURPOSES ONLY AND DOES NOT ATTRACT LEGAL LIABILITY OF ANY KIND FROM WHATSOEVER OR HOWEVER ARISING				DO16/6/4/1/4/C1157.02		SHEETS OF		A0	
									CHECKED BY:	CHECKED BY:	False Bay Building Tygerberg Park 163 Lys Krige Drive Platteklouf, 7500		NAME: DAWIE MALAN		Infrastructure		PROVINCIAL ROADS ENGINEER				CONTRACT NO. C1157.02		WCG STRUCTURE PLAN C12515/05			
									D. MALAN	A. HEARNE	*27 21 9115823 www.hatch.com		ECSA P. No. 94067		FOR YOU		DATE: APRIL 2025		REINFORCEMENT DETAILS WING WALLS		CONSULTANTS DWG NO. H581596-00000-238-272-1791-0002		WCG INDEX NO. A99/135		VER VB	

MEMBER	NO OF	BAR MARK	DIA	NO BARS	TOTAL	CUT LENGTH	SC	A	B	C	D	E/R
Base	1	301A	Y16	2	2	4100	37	200				
	1	301B	Y16	2	2	3800	37	200				
	1	301C	Y16	2	2	3500	37	200				
	1	301D	Y16	2	2	3200	37	200				
	1	301E	Y16	2	2	2950	37	200				
	1	301F	Y16	2	2	2650	37	200				
	1	301G	Y16	2	2	2350	37	200				
	1	301H	Y16	2	2	2050	37	200				
	1	301I	Y16	2	2	1750	37	200				
	1	301J	Y16	2	2	1450	37	200				
	1	301K	Y16	2	2	1200	37	200				
	1	301L	Y16	2	2	900	37	200				
	1	301M	Y16	2	2	600	37	200				
	1	302A	Y16	2	2	7900	37	200				
	1	302B	Y16	2	2	7600	37	200				
	1	302C	Y16	2	2	7300	37	200				
	1	302D	Y16	2	2	7050	37	200				
	1	302E	Y16	2	2	6750	37	200				
	1	302F	Y16	2	2	6450	37	200				
	1	302G	Y16	2	2	6150	37	200				
	1	302H	Y16	2	2	5850	37	200				
	1	302I	Y16	2	2	5550	37	200				
	1	302J	Y16	2	2	5300	37	200				
	1	302K	Y16	2	2	5000	37	200				
	1	302L	Y16	2	2	4700	37	200				
	1	302M	Y16	2	2	4400	37	200				
	1	303	Y16	18	18	8500	38	200	8150			
	1	304A	Y12	2	2	4650	38	200	4280			
	1	304B	Y12	2	2	4350	38	200	3990			
	1	304C	Y12	2	2	4050	38	200	3695			
	1	304D	Y12	2	2	3750	38	200	3400			
	1	304E	Y12	2	2	3450	38	200	3110			
	1	304F	Y12	2	2	3150	38	200	2820			
	1	304G	Y12	2	2	2900	38	200	2525			
	1	304H	Y12	2	2	2600	38	200	2230			
	1	304I	Y12	2	2	2300	38	200	1940			
	1	304J	Y12	2	2	2000	38	200	1650			
	1	304K	Y12	2	2	1700	38	200	1355			
	1	304L	Y12	2	2	1400	38	200	1060			
	1	304M	Y12	2	2	1100	38	200	770			

MEMBER	NO OF	BAR MARK	DIA	NO BARS	TOTAL	CUT LENGTH	SC	A	B	C	D	E/R
	1	305A	Y12	2	2	8450	38	200	8090			
	1	305B	Y12	2	2	8150	38	200	7800			
	1	305C	Y12	2	2	7850	38	200	7505			
	1	305D	Y12	2	2	7550	38	200	7210			
	1	305E	Y12	2	2	7250	38	200	6920			
	1	305F	Y12	2	2	7000	38	200	6630			
	1	305G	Y12	2	2	6700	38	200	6335			
	1	305H	Y12	2	2	6400	38	200	6040			
	1	305I	Y12	2	2	6100	38	200	5750			
	1	305J	Y12	2	2	5800	38	200	5460			
	1	305K	Y12	2	2	5500	38	200	5165			
	1	305L	Y12	2	2	5200	38	200	4870			
	1	305M	Y12	2	2	4950	38	200	4580			
	1	306	Y12	18	18	8500	38	200	8150			
	1	307	Y12	128	128	5900	38	200	5570			
	1	308	Y12	72	72	1350	83	350	250	300	300	

R	6	8	10	12	16	20	25	32	40	TOTAL
Y				1113	590					1704
TOTAL				1113	590					1704

MEMBER	NO OF	BAR MARK	DIA	NO BARS	TOTAL	CUT LENGTH	SC	A	B	C	D	E/R
Cut-Off Beam AS	2	390	Y10	71	142	2550	60	900	300			
	2	391	Y12	8	16	8100	37	600				
	2	392	Y12	20	40	7750	37	250				
Cut-Off Beam Culvert	2	393	Y12	14	28	7200	20	7200				
	2	345	Y10	56	112	2550	60	900	300			
	2	346	Y25	8	16	7300	37	600				
	2	347	Y25	4	8	5000	20	5000				
	2	348	Y12	20	40	6650	37	250				
	2	349	Y12	10	20	4500	20	4500				

R	6	8	10	12	16	20	25	32	40	TOTAL
Y			399	885				604		1889
TOTAL			399	885				604		1889

MEMBER	NO OF	BAR MARK	DIA	NO BARS	TOTAL	CUT LENGTH	SC	A	B	C	D	E/R
Deck - Bottom	1	330A	Y20	2	2	4600	38	200	4280			
	1	330B	Y20	2	2	4300	38	200	3990			
	1	330C	Y20	2	2	4000	38	200	3695			
	1	330D	Y20	2	2	3700	38	200	3400			
	1	330E	Y20	2	2	3400	38	200	3110			
	1	330F	Y20	2	2	3150	38	200	2820			
	1	330G	Y20	2	2	2850	38	200	2525			
	1	330H	Y20	2	2	2550	38	200	2230			
	1	330I	Y20	2	2	2250	38	200	1940			
	1	330J	Y20	2	2	1950	38	200	1650			
	1	330K	Y20	2	2	1650	38	200	1355			
	1	330L	Y20	2	2	1350	38	200	1060			
	1	330M	Y20	2	2	1100	38	200	770			
	1	331A	Y20	2	2	8400	38	200	8090			
	1	331B	Y20	2	2	8100	38	200	7800			
	1	331C	Y20	2	2	7800	38	200	7505			
	1	331D	Y20	2	2	7500	38	200	7210			
	1	331E	Y20	2	2	7250	38	200	6920			
	1	331F	Y20	2	2	6950	38	200	6630			
	1	331G	Y20	2	2	6650	38	200	6335			
	1	331H	Y20	2	2	6350	38	200	6040			
	1	331I	Y20	2	2	6050	38	200	5750			
	1	331J	Y20	2	2	5750	38	200	5460			
	1	331K	Y20	2	2	5500	38	200	5165			
	1	331L	Y20	2	2	5200	38	200	4870			
	1	331M	Y20	2	2	4900	38	200	4580			
	1	332	Y20	18	18	8450	38	200	8150			
	1	333	Y16	63	63	5900	38	200	5570			
	1	334	Y25	28	28	6450	37	200				
	1	335	Y25	14	14	6700	20	6700				
	1	342	Y12	126	126	2500	99	120	50	90	1100	1200
Deck - Top	1	336A	Y16	2	2	4100	37	200				
	1	336B	Y16	2	2	3800	37	200				
	1	336C	Y16	2	2	3500	37	200				
	1	336D	Y16	2	2	3200	37	200				
	1	336E	Y16	2	2	2950	37	200				
	1	336F	Y16	2	2	2650	37	200				
	1	336G	Y16	2	2	2350	37	200				
	1	336H	Y16	2	2	2050	37	200				

MEMBER	NO OF	BAR MARK	DIA	NO BARS	TOTAL	CUT LENGTH	SC	A	B	C	D	E/R
	1	336I	Y16	2	2	1750	37	200				
	1	336J	Y16	2	2	1450	37	200				
	1	336K	Y16	2	2	1200	37	200				
	1	336L	Y16	2	2	900	37	200				
	1	336M	Y16	2	2	600	37	200				
	1	337A	Y16	2	2	7900	37	200				
	1	337B	Y16	2	2	7600	37	200				
	1	337C	Y16	2	2	7300	37	200				
	1	337D	Y16	2	2	7050	37	200				
	1	337E	Y16	2	2	6750	37	200				
	1	337F	Y16	2	2	6450	37	200				
	1	337G	Y16	2	2	6150	37	200				
	1	337H	Y16	2	2	5850	37	200				
	1	337I	Y16	2	2	5550	37	200				
	1	337J	Y16	2	2	5300	37	200				
	1	337K	Y16	2	2	5000	37	200				
	1	337L	Y16	2	2	4700	37	200				
	1	337M	Y16	2	2	4400	37	200				
	1	338	Y16	18	18	8500	38	200	8150			
	1	339	Y16	63	63	5900	38	200	5570			
	1	340	Y16	24	24	3750	37	200				
	1	341	Y25	24	24	6700	20	6700				

R	6	8	10	12	16	20	25	32	40	TOTAL
Y				360	1906	983	1677			4925
TOTAL				360	1906	983	1677			4925

MEMBER	NO OF	BAR MARK	DIA	NO BARS	TOTAL	CUT LENGTH	SC	A	B	C	D	E/R
Outer Wall	2	309	Y16	29	58	2650	51	1500				150